

Enclosure 1

**Analysis of Fish Species Occurrences in Chickamauga Reservoir – A
Comparison of Historical and Recent Data**

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A Comparison of Historical and Recent Data**

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 *1999 Cove rotenone records are from Baxter and Gardner (2000). Exact cove locations for 1999 species records were not specified and are listed in the TRM 471.7-478 column. 1999 samples were collected in coves near TRM 476.2, 478, 495.1, 508, and 524.6.
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Introduction

The Tennessee Valley Authority (TVA) has conducted an extensive amount of fish sampling in Chickamauga Reservoir spanning from 1947 to 2009. Cove rotenone sampling (consists of blocking off a cove on a reservoir and killing fish with a chemical {rotenone} to assess species occurrence and abundance) was conducted from 1947 to 1999 in Chickamauga Reservoir. Gill nets (1971 to 1994), hoop nets (1977 to 1985), trap nets (1971 to 1978), and boat electrofishing (1977 to 1985; 1991) were used during special studies conducted by TVA in Chickamauga Reservoir. Routine reservoir fisheries monitoring was initiated in 1993 using boat electrofishing and gill nets at various stations throughout Chickamauga Reservoir and has continued to present. Additional data on fish species occurrences in Chickamauga Reservoir were obtained during fish impingement mortality sampling (number of fish impinged on trash screens at power plant cooling water intakes), which was conducted during 1981 to 1985, 2001 to 2002, and 2005 to 2007 at Sequoyah Nuclear Plant; during 1974 to 1975 at Watts Bar Steam Plant, which was taken out of operation in 1982; during 1999 to 2000, and 2005 to 2007 at the Watts Bar Nuclear Plant Supplemental Condenser Cooling Water intake (the old Watts Bar Steam Plant intake at Watts Bar Dam) and during 1996 to 1997 at Watts Bar Nuclear Plant.

In addition to reservoir fish sampling, TVA conducted sampling in Chickamauga Reservoir tributary streams and rivers during 1991 to present to assess changes in water quality at a watershed level. Fish collected during these surveys provide additional information on species occurrences within the Chickamauga Reservoir watershed.

This purpose of this report is: (1) to assess differences among gear types in detecting certain fish species in Chickamauga Reservoir from 1947 to 2009 and (2) to examine temporal changes in fish species occurrences during this time period.

Methods

Data Compilation

Data included in this report were compiled from historical reports, raw data files, and TVA reservoir and stream fish databases, which represent all currently known fish species occurrence data from TVA fish collections in Chickamauga Reservoir. Table 2 compiles all species occurrence data from the historical sources. Currently accepted common and scientific names of fishes, as listed by Nelson et al. 2004, were used in this document. Only common names are used within the text of this document, while both common and scientific names are provided in tables and in the appendix.

Sampling Localities

General Description of Chickamauga Reservoir

The construction of Chickamauga Reservoir was completed in 1940. Chickamauga Dam is located at Tennessee River mile (TRM) 471 and impounds 59 miles of the Tennessee River upstream to Watts Bar Dam which is located at TRM 530 (Figure 1). Mainstem Tennessee River reservoirs, such as Chickamauga Reservoir, are typically characterized by 3 distinct zones: the inflow, transition, and forebay. The inflow zone is in the upper reaches of the reservoir and is riverine in nature; the transition zone or mid-reservoir is the area where water velocity decreases due to increased cross-sectional area; and the forebay is the lacustrine area near the dam. Chickamauga Reservoir also contains a large embayment created by the Hiwassee River inflow.

Cove Rotenone Locations

TVA began fish sampling with rotenone in Chickamauga Reservoir in 1947 to determine density of game, forage, and commercially valuable fish species. These data also provided species occurrence information and characterized the general fish community occurring in Chickamauga Reservoir. Samples were taken at various locations annually through 1959 (except during 1948 and 1953). No samples were collected from 1960 through 1969, but annual sampling resumed in 1970 and continued until 1993. Rotenone sampling continued during 1995 until 1999 on a biennial basis. Twenty-two locations were sampled with rotenone throughout Chickamauga

Reservoir; of these, five were sampled for a duration of ≥ 17 years (Table 1). Sampling locations were present within all zones of the reservoir.

Gill Net, Trap Net, Hoop Net, and Boat Electrofishing Locations

Experimental gill nets, hoop nets, and boat electrofishing were used during Watts Bar Nuclear pre-operational monitoring during 1977 to 1979 and 1982 to 1985 (TVA 1980; TVA 1986a). Experimental gill and hoop nets were set at various locations from TRM 524.2 to TRM 524.9 and from TRM 527.4 to TRM 528.4. Boat electrofishing was conducted throughout the same general sample reaches.

Standard gill nets and trap nets were set at TRM's 473, 483.6, and 495, as well as in the Hiwassee River embayment at Hiwassee River mile (HiRM) 1.0 (standard gill nets only), during Sequoyah Nuclear Plant pre-operational monitoring from 1971 to 1978 (TVA 1978). Initial Sequoyah Nuclear Plant operational monitoring was conducted using standard gill nets from 1980 to 1986 at TRM's 473, 483, and 495 (TVA 1982; TVA 1985; TVA 1986b). Experimental gill nets were used during 1986 at areas within TRM 482.7 to TRM 487.6 (TVA 1987).

A special study to evaluate population dynamics of sauger in Chickamauga Reservoir was conducted during 1986 to 1994, using both standard and experimental gill nets. In addition to sauger, data were collected on all other species captured in gill nets. Sampling was conducted in the upper 14.9 miles of Chickamauga Reservoir (TRM 515 to TRM 529.9) during 1986 and 1988 (Hevel 1987; Hickman et al. 1989). During 1989 to 1991 and 1993 to 1994, sampling was conducted at TRM's 521 and 529 (Hickman et al. 1990; Hevel and Hickman 1991; Hickman and Buchanan 1995).

During 1991, a special study was conducted to evaluate the condition of fish communities in Chickamauga Reservoir embayments (Hevel and Hickman 1992). Experimental gill nets were set in nine embayments located from TRM 477 upstream to TRM 514 and in six embayments in the Hiwassee River arm of the reservoir which were located from HiRM 7 upstream to HiRM 16. Boat electrofishing was also conducted in each embayment.

Beginning in 1993 and continued to present, annual reservoir fish monitoring was implemented in Chickamauga Reservoir utilizing Reservoir Fish Assemblage Index (RFAI) methodology to evaluate changes in the ecological health of fish communities (Simmons 2010a). RFAI has been thoroughly tested on TVA and other reservoirs and published in peer-reviewed literature (Jennings et al. 1995; Hickman and McDonough 1996; McDonough and Hickman 1999).

Monitoring stations were established in the inflow, transition, and forebay zones of the reservoir, as well as in the Hiwassee River embayment. The Chickamauga Reservoir inflow sample site is located at Tennessee River mile (TRM) 529.0 below Watts Bar Dam, the transition zone sampling station is located at TRM 490.5, two sites in the forebay are located at TRM 482 and TRM 472.3, and a site on the Hiwassee River embayment of Chickamauga Reservoir is located at HiRM 8.5 (Figure 1). Boat electrofishing and experimental gill nets are the sampling gear used at each of the sampling localities with the exception of the inflow site, where only boat electrofishing is conducted.

Free-flowing Tributary Sample Locations

Of the numerous tributaries flowing into Chickamauga Reservoir, the Hiwassee River is undoubtedly the largest. For the purpose of this report, data collected in the Hiwassee River system are presented separately from those from smaller direct tributaries to Chickamauga Reservoir; faunal differences and sampling protocols differ between the two (large drainage area versus smaller drainage area). During the early 1990's, TVA began sampling free-flowing streams and rivers throughout the Tennessee River system to assess water quality conditions at a watershed level. TVA adapted Index of Biotic Integrity (IBI) methodology (Karr et al. 1986) to the Tennessee River system, which uses fish assemblage composition, abundance, and condition as an indicator of water quality. Within the Hiwassee River system in Tennessee, 56 locations were sampled from 1991 to 2010 and 37 locations were sampled in smaller direct tributaries to Chickamauga Reservoir during 1995 to 2009 (Figure 2).

Brief Synopsis of Sampling Methods

Cove Rotenone

Rotenone samples were conducted by isolating fish populations of a cove from the main body of the reservoir by stretching a block net across the cove and anchoring the bottom of the net to preclude immigration/emigration of fish in the sample area. Toxicant (rotenone) was applied

throughout the water column at a concentration of 1 mg/l and fish were collected as they floated to the surface. Potassium permanganate was applied at 1 mg/l outside the sample area to buffer the rotenone and prevent any unnecessary fish mortality. Fish collection was conducted for at least a two-day minimum after application of rotenone to pick up fish that may have floated to the surface overnight. Fish were identified to species, measured, weighed, and recorded.

Gill Netting

Gill nets are typically constructed of monofilament mesh netting and trap fish that swim into the net. Gill nets are used as an additional gear type to collect fish from deeper habitats not effectively sampled by electrofishing. Gill nets are less effective than hoop nets or electrofishing for capture of some species due to body shapes, limited movement exhibited by some species (hence less probability of encountering the net), or the affinity for cover, where gill nets cannot be effectively fished due to snagging problems. Gill nets are usually set perpendicular to the shoreline or channel. Each net is weighted with a lead line to keep the bottom of the net on the river bottom and contains a float line on the top portion of the net to keep the net standing vertical. An anchor is secured to each end of the lead line to keep the net in place and a float is secured to each end of the float line so that the nets can be retrieved. When gill nets are set in non-flowing waters, few problems are encountered other than occasional underwater obstructions that may snag a net. When nets are set in flowing waters, they are much more likely to become snagged as the current moves them along the bottom, unless sufficient weight is used to prevent any movement. They are also particularly susceptible to becoming fouled with debris, such as leaves and senescent aquatic vegetation, particularly in fall and winter months.

Both standard and experimental gill nets have been used by TVA while sampling in Chickamauga Reservoir. Standard gill nets were 30.5 m (100 ft) long by 2.4 m (8 ft) tall and contained 3.8 cm mesh (1.5 in) (TVA 1978; TVA 1982; TVA 1984; TVA 1985; Hevel 1987; Hickman et al. 1989; Hickman et al. 1990; Hickman and Buchanan 1995). Experimental gill nets employ several panels (sections) of various mesh sizes in succession rather than one mesh size throughout the length of the net. This allows for a more complete collection of various size classes of most species, as well as smaller species that may not be taken with larger mesh nets. Experimental gill nets used during Watts Bar Nuclear Plant pre-operational and initial operation monitoring were 38.1 m (125 ft) long by 2.4 m (8 ft) tall and contained five panels with mesh

ranging from 1.27 cm (0.5 in) to 6.55 cm (2.5 in) (TVA 1980; TVA 1986a). A special study to evaluate freshwater drum population in Chickamauga Reservoir used experimental gill nets which were 68.6 m (225 ft) long by 2.4 m (8 ft) tall and contained mesh panels ranging from 2.5 cm (1 in) to 12.7 cm (5 in) (TVA 1987). During special studies evaluating Chickamauga Reservoir sauger populations and embayments, experimental gill nets used were 30.5 m (100 ft) long by 2.4 m (8 ft) tall and contained five panels with mesh ranging from 2.5 cm (1 in) to 7.6 cm (3 in) (Hevel 1987; Hickman et al. 1989; Hickman et al. 1990; Hevel and Hickman 1991; Hevel and Hickman 1992; Hickman and Buchanan 1995). Routine reservoir sampling conducted from 1993 to present is conducted with experimental gill nets, 30.5 m (100 ft) long by 2.4 m (8 ft) tall, containing five panels with mesh ranging from 2.5 cm (1 in) to 12.7 cm (5 in) (Simmons 2010a). Of the five current Chickamauga Reservoir sampling stations, gill nets are used at all stations except the inflow station (TRM 529). All current reservoir stations are sampled during autumn to examine the condition of the fish community at the end of the “biological year” to evaluate how the fish community has responded to stressors (natural and anthropogenic) throughout the year. As mentioned above, gill nets set in flowing water during the fall are routinely ineffective due to clogging from organic matter. Additionally, higher water velocities reduce the integrity of the net set.

Hoop and Trap Netting

Hoop nets allow fish to enter a netted enclosure through a series of one or more funnels attached to a series of hoops. Hoop nets can be used in free-flowing rivers or in reservoir inflows where current velocities are greater. Trap nets contain a leader and two wings that lead to the net opening. The leader runs down the center to the mouth of the net and the wings are anchored at 45-degree angles to each side of the net and connect at the mouth. When fish moving along the shore encounter the net, they follow the net leader into the netted enclosure where escape is difficult. Trap nets are most applicable to transition and forebay reservoir conditions due to lack of rigidity which makes them ineffective in flowing water.

Hoop nets used during Watts Bar Nuclear Plant pre-operational monitoring contained seven hoops, two funnels, and were 7.6 m (25 ft) long (TVA 1980; TVA 1986a). Trap nets used during Sequoyah Nuclear Plant pre-operation sampling were placed along shorelines and were 3 m (9.8 ft) long (TVA 1978).

Boat Electrofishing

Electrofishing basically involves using a power source (generator) and wire leads (electrodes) to send direct electric current (dc) into the water. A control box (transformer that converts alternating current {ac} to dc) allows the operator to adjust current output based on water conductivity for maximum shocking efficiency. When the number of volts and amperes are correctly matched to the conductivity of the water, fish are temporarily stunned and collected with dip nets. Duration and length of electrofishing runs varied during historical sampling. Current boat electrofishing sampling (1993 to present) consists of 15 boat electrofishing runs near the shoreline, each 300 m long, with a duration of approximately 10 minutes each. The total near-shore area sampled is approximately 4,500 m (15,000 ft).

Impingement Sampling

Power plant cooling water intakes result in impingement of fish and debris on trash screens during operation. Numerous studies were conducted at Watts Bar Nuclear Plant, Watts Bar Steam Plant, Watts Bar Nuclear Plant Supplemental Condenser Cooling Water intake, and Sequoyah Nuclear Plant to estimate the species composition and number of adult fish that were impinged during plant operations. Traveling screens were backwashed and fish were collected as the water passed through a steel mesh basket at the end of the screen wash sluice pipe. Impinged fish were identified to species, measured, weighed, and recorded.

Free-flowing Tributaries

TVA IBI methodology is designed to deplete habitat sections in an effort to document every species present at a site. Backpack-mounted electrofishers are used to shock fish in run and riffle habitats into a 20-ft seine. Pool habitats are sampled by seine hauls. Shorelines sections (e.g. undercut banks, root wads, woody debris piles) are shocked and fish are netted as encountered. Every time a new species is encountered, three additional efforts in a particular habitat must be conducted until no new species are encountered. Streams or rivers with a drainage area of ≥ 100 square miles are also sampled with a small boat electrofishing unit to capture larger pool species.

Results and Discussion

Comparison of Species Records by Sampling Method

TVA fish sampling from 1947 to 2009, has resulted in collection of 88 fish species. Of these, five are questionable records (Table 2). Cove rotenone surveys have resulted in collection of 73 species, three of which are questionable records, while boat electrofishing, gill net, hoop net, and trap net sampling from 1971 to 2009 have also resulted in collection of 73 species, two of which are questionable records (Table 2). Impingement samples from Sequoyah Nuclear Plant, Watts Bar Steam Plant, Watts Bar Nuclear Plant, and Watts Bar Nuclear Plant Supplemental Condenser Cooling Water intake have resulted in collection of 50 species, one of which is a questionable record (Table 2).

Shortnose gar, mud darter, orangethroat darter, pumpkinseed, and sawfin shiner were recorded in TVA Chickamauga Reservoir samples, but were most likely misidentified and therefore are questionable species records. Shortnose gar was recorded in electrofishing, gill net, and rotenone surveys; these records were probably a misidentification of spotted gar. The currently understood distribution of shortnose gar in the Tennessee River system is restricted to the larger downstream reaches (Etnier and Starnes, 1993), which is concurrent with TVA RFAI data (Kentucky Reservoir). Some of the more upstream records in the Tennessee River system may be based on poorly marked spotted gars (D.A. Etnier, University of Tennessee, Knoxville, personal communication, 2010).

Mud darter and orangethroat darter cove rotenone records are almost certainly erroneous. In Tennessee, mud darters are distributed in direct tributaries to the Mississippi River and in tributaries to the lower Tennessee (Kentucky Reservoir) and Cumberland Rivers (Barkley Reservoir) (Etnier and Starnes 1993). Orangethroat darters are distributed in the Cumberland River system and in the lower Tennessee River system upstream to Pickwick Reservoir within Tennessee (Etnier and Starnes 1993). Both of these species can be, and probably were, confused with the rainbow darter.

Two records for pumpkinseed, one individual collected in a gill net and one individual collected in a trap net during the 1970's, are most likely invalid (TVA 1978). This species is not native to Tennessee; the only valid records are from introduced populations in east Tennessee Reservoirs (South Holston and Boone Reservoirs) (Etnier and Starnes 1993; Wallus 2008). An early record of pumpkinseed from Reelfoot Lake in western Tennessee was actually a hybrid combination of other *Lepomis* species (Etnier and Starnes 1993). Sunfish commonly hybridize which increases the probability of misidentification. Some non-native species, once introduced into a river system, are able to quickly disperse through a system. Pumpkinseeds have not demonstrated this dispersal capability where they have been introduced (Wallus 2008).

Most likely, sawfin shiners collected during 1980-1981 Sequoyah Nuclear Plant impingement samples were misidentified as mimic shiners. Mimic shiners have been able to adapt to reservoir conditions, while sawfin shiners are typically only found in free-flowing streams and rivers (Etnier and Starnes 1993). Additionally, no records of sawfin shiners exist from Chickamauga Reservoir or tributaries (Etnier and Starnes 1993).

Rotenone versus Electrofishing, Gill nets, Hoop Nets, Trap Nets

Although the same number of species has been collected in rotenone samples compared with electrofishing, gill net, hoop net, and trap net samples, there are differences in species composition relative to sampling method. In rotenone samples, 11 species, two of which are questionable records, were collected which were not encountered during Chickamauga Reservoir sampling with the other four sampling methods (blackspotted topminnow, blackstripe topminnow, fathead minnow, ghost shiner, mimic shiner, pugnose minnow, rainbow darter, stripetail darter, whitetail shiner; and questionable records, mud darter, orangethroat darter). In electrofishing, gill net, hoop net, and trap net samples, 9 species, one of which is a questionable record, were collected which were not encountered during rotenone surveys (alewife, American eel, Atlantic needlefish, brown trout, dusky darter, grass carp, inland silverside, lake sturgeon, rainbow trout; and a questionable record, pumpkinseed). No species were collected using hoop nets and trap nets that were not collected using electrofishing or gill nets.

Of the nine valid species collected in rotenone surveys that were not encountered using the other sampling gear (blackspotted topminnow, blackstripe topminnow, fathead minnow, ghost shiner,

mimic shiner, pugnose minnow, rainbow darter, stripetail darter, whitetail shiner), five are not typically found in reservoirs or occur in shallow backwater areas of reservoirs that are sampled during cove rotenone surveys but are not sampled during TVA electrofishing surveys (blackspotted topminnow, blackstripe topminnow, rainbow darter, stripetail darter, whitetail shiner). These species are too small to be collected using the other gear types (gill nets, hoop nets, trap nets). Because rotenone samples were conducted in coves in proximity to occasional stream inflows, stream fishes such as blackspotted topminnows, whitetail shiners, stripetail darters, and rainbow darters were encountered. Blackstripe topminnows are more ubiquitous in their habitat use than blackspotted topminnows; they can commonly occur in reservoirs, rivers, and streams in slackwater habitats (Etnier and Starnes 1993). Fathead minnows were collected only during a 1979 rotenone sample. This species is one of the most commercially available bait fishes used by anglers. Because they have been so widely used for bait, it is unknown if this species is even native to the Tennessee River system. There are very few reproducing populations within the state which suggests that fathead minnows may not be indigenous to this region (Etnier and Starnes 1993). Ghost shiners were collected periodically in rotenone surveys from 1974 to 1999 in Chickamauga Reservoir. A majority of these records were from coves located between TRM's 471.7 and 478, which is the forebay area of the reservoir. Ghost shiners occur in the mid-water of large streams and reservoirs, making them difficult to collect. Electrofishing runs are conducted along shorelines which would greatly reduce the probability of collecting this minnow. Pugnose minnows were collected periodically from 1975 to 1990 in rotenone samples. Chickamauga Reservoir is near the upper end of the distribution of the pugnose minnow in the Tennessee River System where it does not appear to be as common as in the lower Tennessee River system (Etnier and Starnes 1993; Boschung and Mayden 2004). Mimic shiners were collected in rotenone samples from 1976 to 1978 and during 1984 (Appendix 1). Although this species can tolerate reservoir environments, it is more common in large creeks and small rivers (Etnier and Starnes 1993).

Of the nine valid species collected in electrofishing and gill net samples which were not encountered in cove rotenone surveys (alewife, American eel, Atlantic needlefish, brown trout, dusky darter, grass carp, inland silverside, lake sturgeon, rainbow trout), six are non-native. Several of these species appeared in Chickamauga Reservoir after 1999 when cove rotenone

samples were terminated. Alewives were introduced into Watauga and Dale Hollow Reservoirs in 1976 by the Tennessee Wildlife Resources Agency (TWRA) to provide additional forage for sportfish. They have since expanded their distribution downstream in the Tennessee and Cumberland River systems. Atlantic needlefish were first collected in TVA samples in Pickwick Reservoir in 2007. They have since been collected by TVA biologists in Kentucky, Gunter'sville, and Chickamauga Reservoirs. It is unknown whether they entered the Tennessee River System from the Ohio River or from the Tombigbee River via the Tennessee-Tombigbee Waterway. Similarly, inland silversides have invaded the Tennessee River system from 1991 to present. This species was first collected in Kentucky Reservoir in 1991 and appeared in Chickamauga Reservoir in 2004. Grass carp is an Asian species that has been widely introduced to control aquatic vegetation. Brown and rainbow trout are stocked for recreational angling by the TWRA in the Hiwassee River, a tributary to Chickamauga Reservoir.

The three native species (American eel, lake sturgeon, dusky darter) are not commonly collected in Tennessee River reservoirs for a variety of reasons. Lake sturgeon were rare, if not extirpated, in the Tennessee River system by the mid-half of the twentieth century. Efforts, partially funded by TVA, began in 1998 to re-introduce this species to the Tennessee River. Subsequently, re-introduced individuals have been collected in recent times. Because American eels are catadromous (live in freshwater but migrate to saltwater to spawn), they are no longer common in the Tennessee River system due to the series of dams that impede their migration. The only TVA record in Chickamauga Reservoir was from the late 1970's (TVA 1980). This species presently may or may not occur naturally in the upper Tennessee River system; live individuals of this species have been seen for sale in bait shops on Fort Loudon Reservoir near Knoxville (J.W. Simmons, personal observation). Dusky darters are typically inhabitants of large creeks and rivers in areas with moderate current and woody debris (Etnier and Starnes 1993). This species' occurrence in Chickamauga Reservoir is represented by one individual collected during autumn 2009 in the Hiwassee River embayment (Simmons 2010a). Dusky darters have been collected on numerous occasions in recent years in TVA stream and river sampling in the Hiwassee River and its tributaries upstream from the impoundment (Table 4).

Impingement samples

Impingement samples have yielded four species, one of which is questionable, that were not collected with the use of rotenone, electrofishing, gill nets, hoop nets, or trap nets (banded sculpin, river chub, tangerine darter; and a questionable record, sawfin shiner). Of these, banded sculpin, river chub, and sawfin shiner were collected in impingement samples at Sequoyah Nuclear Plant and tangerine darter was collected in Watts Bar Nuclear Plant Supplemental Condenser Cooling Water intake impingement samples (Table 2) (TVA 1982; TVA 1985; TVA 2007b). All of the aforementioned species are typically inhabitants of creeks and small rivers and are rarely encountered in reservoir environments. These species may have been displaced during a high water event from their normal stream habitats into the reservoir, possibly as juveniles (e.g. Harvey 1987). Increased water velocities produced by power plant water intakes create habitats different than those typically found in impounded waters. These species adapted to free-flowing environments may have been attracted to this habitat, and consequently were impinged. Of these, none were collected in large numbers (banded sculpin, seven individuals; river chub, seven individuals; tangerine darter, one individual). The collection of a tangerine darter in Watts Bar Nuclear Plant Supplemental Condenser Cooling Water intake impingement samples was surprising; this species is still extant in many free-flowing tributaries to the Tennessee River but was presumed to be extirpated from the mainstem Tennessee River due to impoundments (Etnier and Starnes 1993). The Watts Bar Nuclear Plant Supplemental Condenser Cooling Water intake is located in Watts Bar Reservoir, just upstream of Watts Bar Dam. Tangerine darters are present in the Emory River, a tributary to Watts Bar Reservoir, and this individual could have been displaced into the reservoir during a high flow event.

Most likely, sawfin shiners were misidentified as mimic shiners. TVA (1982) lists sawfin shiners as being collected in 1980-1981 Sequoyah Nuclear Plant impingement samples with no mention of mimic shiners, while TVA (1986b) lists only mimic shiners in a summary of species collected in Sequoyah Nuclear Plant impingement samples from 1981 to 1985 with no mention of sawfin shiners.

Temporal Changes in Fish Species Occurrences

Of the 83 valid species records obtained during TVA fish sampling in Chickamauga Reservoir from 1947 to 2009, six have not been collected in Chickamauga Reservoir since the 1970's (American eel, bigmouth buffalo, brown trout *non-native*, fathead minnow *non-native*, silver chub, and whitetail shiner); four have not been collected in Chickamauga Reservoir since the 1980's (banded sculpin, blackstripe topminnow, mimic shiner, and river chub); and 16 have not been collected in Chickamauga Reservoir since the 1990's (black bullhead, blackspotted topminnow, ghost shiner, goldfish *non-native*, grass carp *non-native*, highfin carpsucker, orangespotted sunfish, paddlefish, pugnose minnow, quillback, rainbow darter, rainbow trout *non-native*, river carpsucker, smallmouth redhorse, stripetail darter, and white sucker). Five species have been collected during 2000 to 2009 that were never previously collected in TVA samples in Chickamauga Reservoir (Atlantic needlefish *non-native*, dusky darter, inland silverside *non-native*, lake sturgeon, and tangerine darter).

These temporal changes in fish species occurrence are discussed in detail below by time period:

Species not collected since the 1970's

Two of the six species that have not been collected since the 1970's are not native to the Tennessee River (brown trout and fathead minnow). Brown trout collected from Chickamauga Reservoir were presumably disoriented migrants from TWRA stocked populations in the Hiwassee River. Chickamauga Reservoir habitats would not be suitable long-term due to water temperatures that exceed the upper lethal limit for these cold water species. Fathead minnows were probably locally introduced by bait fisherman and were unable to establish a viable population. As previously discussed, natural populations of American eels have most likely been extirpated from Chickamauga Reservoir (and the majority of the Tennessee River) by the series of dams on the river system which impede downstream adult migration to reproduce and upstream migration by juveniles. Bigmouth buffalo were sporadically collected in cove rotenone samples in 1947, the 1950's, and the 1970's. During Sequoyah Nuclear Plant pre-operational sampling conducted during 1971 to 1978, 13 individuals were collected; two in gill nets and 11 in trap nets (TVA 1978). During Watts Bar Nuclear Plant pre-operational sampling conducted during 1977 to 1985, 12 individuals were collected in hoop nets (TVA 1986a). None were encountered while electrofishing or in gill nets. In the Tennessee River system, bigmouth

buffalo is the least encountered species of the three buffalo species occurring in the system, possibly due to loss of reproductive habitats from flood control (Etnier and Starnes 1993). This species spawns in response to spring floods, often in flooded fields. It is also important to note that of the 25 individuals collected, 23 were collected in hoop nets or trap nets and no individuals were collected while electrofishing. Lack of TVA records in recent times may be related to current sampling gear used (electrofishing and gill nets).

Silver chubs were collected during 1974 to 1978 in rotenone samples. The only other records from Chickamauga Reservoir were during 1977 to 1985 Watts Bar Nuclear Plant pre-operational sampling; one individual was collected while electrofishing and 32 individuals were collected in gill nets (TVA 1986a). During the past 15 years, TVA has not used gill nets in the inflow area of Chickamauga Reservoir where these individuals were collected. Therefore, the absence of this species during the past two decades may be related to the change in sampling methods.

Whitetail shiners are not typically encountered in reservoirs. The only TVA record of this species in Chickamauga Reservoir was from a 1971 cove rotenone survey (Appendix 1). This species is common in free-flowing stream and river tributaries to Chickamauga Reservoir and has been collected frequently at TVA tributary sampling sites during 1991 to 2010 (Tables 3 and 4). Whitetail shiners collected during 1971, were likely collected using cove rotenone because the sampling technique could easily include stream fish occurring near the mouth of a cove tributary.

Species not collected since the 1980's

The four species that have not been encountered in Chickamauga Reservoir since the 1980's are all primarily found in stream or river environments and are rarely encountered in reservoirs (banded sculpin, blackstripe topminnow, mimic shiner, and river chub). The only records of banded sculpins and river chubs were from Sequoyah Nuclear Plant impingement samples (each represented by seven individuals) (TVA 1982; TVA 1985). Both of these species have been collected in TVA Chickamauga Reservoir stream and river tributary samples in recent years (Tables 3 and 4). Thus, these species are present in their preferred habitats within the Chickamauga Reservoir watershed, and probably were impinged as a result of displacement from tributaries. While mimic shiners can adapt to reservoir environments, they are more common in

stream environments. Mimic shiners were collected in 1976 to 1978 rotenone samples and in Sequoyah Nuclear Plant impingement samples (Appendix 1; Table 3). This species has not been encountered in Chickamauga Reservoir tributaries in TVA stream sampling (Tables 3 and 4). Etnier and Starnes (1993) indicate that mimic shiners are uncommon in this portion of the Tennessee River system. Blackstripe topminnows are represented by 3 rotenone collections from 1972 to 1981 (Appendix 1). This species is commonly confused with blackspotted topminnow (Etnier and Starnes 1993) and absence of this species from recent datasets may be due to misidentification. Backwater areas where this species occurs in reservoirs are not currently sampled during TVA electrofishing surveys. Blackspotted topminnows have been collected in recent years in Chickamauga Reservoir stream and river tributary samples, while blackstripe topminnows have not been collected since 1999 (Tables 3 and 4).

Species not collected since the 1990's

Sixteen species have not been encountered in TVA samples in Chickamauga Reservoir since the 1990's (black bullhead, blackspotted topminnow, ghost shiner, goldfish, grass carp, highfin carpsucker, orangespotted sunfish, paddlefish, pugnose minnow, quillback, rainbow darter, rainbow trout, river carpsucker, smallmouth redhorse, stripetail darter, and white sucker). Of these, three are non-native (goldfish, grass carp, and rainbow trout) and four are primarily found in stream or river environments and are rarely encountered in reservoirs (blackspotted topminnow, rainbow darter, stripetail darter, and white sucker). Rainbow darters, stripetail darters, and white suckers have all been collected in recent TVA samples in free-flowing tributaries to Chickamauga Reservoir (Tables 3 and 4).

Black bullheads have never been common in TVA Chickamauga Reservoir samples. This species was collected periodically in rotenone samples in 1972, 1979, 1981-1983, and in 1993 (Appendix 1). Only one individual was collected in gill net surveys during Sequoyah Nuclear Plant pre-operational monitoring from 1971 to 1978 and six individuals were collected in gill nets near Sequoyah Nuclear Plant during 1980 to 1985 (TVA 1978; TVA 1986b). Four individuals were collected (two in gill nets, two in hoop nets) during Watts Bar Nuclear Plant pre-operational monitoring from 1977 to 1985 (TVA 1986a). Black bullheads and brown bullheads are very difficult to distinguish without counting gill rakers (Etnier and Starnes 1993). It is possible that brown bullheads were mistaken for black bullheads, especially since brown

bullheads are much more common in reservoir habitats. Black bullheads have been collected in TVA Chickamauga Reservoir tributary stream and river fish samples from 1995 to 2007 (Table 3).

As previously discussed, ghost shiners were collected periodically in rotenone surveys from 1974 to 1999 in Chickamauga Reservoir and have not been encountered using any other sampling method. A majority of these records were from coves located between TRM's 471.7 and 478, which is the forebay area of the reservoir. Ghost shiners typically occur in the mid-water of large streams and reservoirs, making them difficult to collect. Electrofishing is conducted in shallow areas along shorelines which would greatly reduce the probability of collecting this minnow. Since 1999, electrofishing and gill nets have been the only sampling methods used in Chickamauga reservoir.

Very few highfin carpsuckers have been collected in TVA samples in Chickamauga Reservoir. The only rotenone collection was during 1949 (Appendix 1). During 1994, one individual was collected while electrofishing at TRM 490.5 (Simmons 2010a) and two individuals, one in a gill net and one in a hoop net, were collected in Watts Bar Nuclear Plant pre-operational monitoring (TVA 1986a). This species is susceptible to change by siltation and impoundment, and is much more common in large free-flowing rivers than in reservoirs. This species is not very common within the Tennessee River system; it is much more abundant in the free-flowing rivers in the Gulf Coastal Plain to the south (Etnier and Starnes 1993).

River carpsuckers were collected periodically in TVA samples throughout Chickamauga Reservoir during the 1970's, 1980's, and early 1990's¹ (Table 2). Although this species was present in samples over a 33-year period, a majority of the records were represented by one individual each. Only two individuals were collected by electrofishing (Simmons 2010a; TVA 1986a), 14 individuals were collected with gill nets (TVA 1978; TVA 1986a; Hevel 1987; Hickman et al. 1990; Hevel and Hickman 1992), eight individuals were collected with trap nets (TVA 1978), and one individual was collected with hoop nets (TVA 1986a). River carpsuckers

¹ After this report was completed, a juvenile river carpsucker was collected in a TVA electrofishing sample at Tennessee River Mile 529 (Chickamauga Reservoir inflow) on September 29, 2010.

were not collected in any free-flowing tributaries draining to Chickamauga Reservoir with the exception of the Hiwassee River (Tables 3 and 4). In the Tennessee River system, river carpsuckers are abundant in the lower Tennessee River, but less common in more upland areas in the eastern portion of the system (Etnier and Starnes 1993).

Similar to the other carpsuckers, quillbacks have rarely been encountered within Chickamauga Reservoir. In rotenone surveys, this species was collected only during 1947, 1950, 1970, and 1984 (Appendix 1). No individuals of this species have been collected in electrofishing samples, 22 individuals were collected with gill nets (TVA 1978; TVA 1986a; Hickman et al. 1990; Hevel and Hickman 1991; Hevel and Hickman 1992; Hickman and Buchanan 1995), and three individuals were collected with trap nets (TVA 1978). It is interesting to note that six of the 22 individuals collected in gill nets were during a 1991 embayment study (Hevel and Hickman 1992). Fifteen embayments within Chickamauga Reservoir were included in this study, four of which were near the upper end of impoundment of the Hiwassee River by Chickamauga Reservoir. This species was collected in three of the four Hiwassee River embayments near the upper end of the impounded portion of the Hiwassee River and were not encountered in any of the other 12 embayments sampled within Chickamauga Reservoir. This species has been consistently collected in the free-flowing section of the Hiwassee River during 1993 to 2007 (Table 4), which is consistent with its distribution throughout the Tennessee River system (affinity for un-impounded rivers) (Etnier and Starnes 1993).

Very few smallmouth redhorse have been collected in Chickamauga Reservoir. The most recent collection was during 1999, when one individual was collected in the Chickamauga Reservoir inflow and one individual was collected in the Hiwassee River embayment, both during electrofishing (Simmons 2010a). This species was collected in four rotenone samples from 1970 to 1977 (Appendix 1). Four individuals were collected in trap nets and two individuals were collected in gill nets during the 1970's and early 1980's (TVA 1978; TVA 1986a). One additional individual was collected while gill netting in 1994 (Hickman and Buchanan 1995). Smallmouth redhorse typically occur in large rivers over gravel to boulder substrates with swift flow and occasionally occur in reservoirs, especially those with large tributaries (Etnier and Starnes 1993). Chickamauga Reservoir only has one large tributary, the Hiwassee River, which

probably limits the distribution of smallmouth redhorse in the reservoir. This species has been collected frequently in the free-flowing portions of the Hiwassee River system in TVA samples collected during 1991 to 2009 (Table 4).

Orangespotted sunfish occur sporadically in mainstem Tennessee River reservoirs, but are most common in backwaters of turbid, sluggish streams in west Tennessee (Etnier and Starnes 1993). This species was collected in Chickamauga Reservoir rotenone samples from 1949 to 1990 (Appendix 1). The only other record was from a gill net sample in the early 1980's, represented by one individual (TVA 1986b). This species has not been collected in TVA samples from direct tributaries to Chickamauga Reservoir or in the Hiwassee River basin, most likely due to lack of preferred habitat (Tables 3 and 4). Since orangespotted sunfish prefer backwaters, such as those in coves of Chickamauga Reservoir, current sampling methods and sampling localities in Chickamauga Reservoir are less likely to encounter this species than the earlier rotenone sampling of coves.

Paddlefish are still widespread in mainstem Tennessee River impoundments but have not been collected in routine fish community monitoring conducted during 1993 to 2009 in Chickamauga Reservoir. A majority of paddlefish collections were in the inflow area of Chickamauga Reservoir. This species was collected in rotenone samples during 1977, 1979, and 1981 near TRM 524 (Appendix 1); 45 individuals were collected in gill nets during Watts Bar Nuclear Plant pre-operational monitoring near TRM 524 and 528; and nine were collected in gill nets near TRM 521 during 1990 and 1993 (TVA 1986a; Hevel and Hickman 1991; Hickman and Buchanan 1995). Other collections were made near Sequoyah Nuclear Plant (~TRM 484); 44 were collected in trap nets during Sequoyah Nuclear Plant preoperational monitoring during the 1970's and one was collected in a gill net in 1986 (TVA 1978; TVA 1987). It is important to note that no paddlefish were collected in electrofishing samples. Gill nets have not been used in samples from 1993 to 2009 in the inflow area of Chickamauga Reservoir which may explain the absence of this species in TVA samples during recent times.

In Chickamauga Reservoir TVA samples, pugnose minnows have been collected only with rotenone (Table 2). This species has not been encountered in any tributaries to Chickamauga

Reservoir (Tables 3 and 4). Chickamauga Reservoir is near the upper end of distribution of the pugnose minnow in the Tennessee River system where it does not appear to be as common as in the lower Tennessee River system (Etnier and Starnes 1993; Boschung and Mayden 2004). This species is too small to be collected in gill nets, hoop nets, or trap nets; thus, rotenone and electrofishing were the only other sampling methods used that may have detected this species. The presence of pugnose minnows in rotenone samples only may indicate that current electrofishing samples are not conducted in habitats used by this species within Chickamauga Reservoir.

Summary and Conclusions

The species composition of the fish assemblage of Chickamauga Reservoir has changed somewhat, but not markedly, over the decades of sampling by TVA. Although some species appear to have been lost between early and more recent sampling, and some species have appeared recently, the differences are readily explained as a result of known differences in effectiveness of various fish sampling methods and habitats they sample. A few early records appear to represent erroneous species identifications.

Of the 88 fish species records from Chickamauga Reservoir collected during 1947 to 2009, five are most likely erroneous. With the exclusion of these questionable records, 70 species were collected during rotenone sampling and 71 species were collected using electrofishing, gill nets, hoop nets, and trap nets. Impingement samples contained 49 valid species records.

Nine valid species records were collected in rotenone samples that were not collected with other sampling methods. Of these, five are not typically found in reservoirs or occur in shallow backwater areas of reservoirs that were not sampled during TVA electrofishing surveys and are too small to be captured with gill nets, hoop nets, or trap nets. Eight valid species records were collected during electrofishing, gill netting, hoop netting, and trap netting that were not encountered in rotenone samples. Of these, six are non-native, many of which were collected for the first time after rotenone sampling was terminated. The remaining three native species are not

commonly collected in Tennessee River reservoirs for a variety of reasons. All species collected in trap nets and hoop nets were also encountered in electrofishing and gill net surveys.

Three valid species records were obtained in impingement samples that were not encountered using any of the aforementioned sampling methods. These species are typically found in free-flowing streams or rivers and are rarely collected in reservoirs. Impingement, by definition, captures fish that are unable to resist the inflowing current of water intakes and become stuck on the intake screens. Impinged fish can be categorized in two groups; healthy but hapless individuals that accidentally get caught and unhealthy fish that are lethargic, moribund, or dead and often out of their normal habitat. It is not unreasonable to suspect that a stream fish displaced into reservoir habitats might be lethargic, disoriented, or dead and vulnerable to drifting into the intake where it is impinged.

Of the 83 valid species records obtained during TVA fish sampling in Chickamauga Reservoir from 1947 to 2009, six have not been encountered in Chickamauga Reservoir since the 1970's, four have not been encountered since the 1980's, and 16 have not been encountered since the 1990's. Of these, five are non-native. Five additional species have been collected during 2000 to 2009 that were never previously collected in Chickamauga Reservoir, two of which are non-native. Of the 21 native species that have not been collected in recent times (2000 to 2009), nine are most adapted to stream/small river environments (whitetail shiner, banded sculpin, blackspotted topminnow, blackstripe topminnow, mimic shiner, river chub, rainbow darter, stripetail darter, white sucker, and black bullhead), five are most adapted to medium to large free-flowing rivers (bigmouth buffalo, highfin carpsucker, quillback, river carpsucker, and smallmouth redhorse), one species is catadromous (American eel) and has been severely affected by the series of dams that impede their migration, and five are not as susceptible to current collection methods or occur sporadically throughout the upper Tennessee River system (ghost shiner, pugnose minnow, silver chub, orangespotted sunfish, and paddlefish). Ten of the 21 native species that have not been collected during recent times were only collected in rotenone (eight species) or impingement samples (three species), which indicate that current sampling methods are not effective in documenting the presence of these species.

A similar analysis of recent and historical fish data was conducted for Guntersville Reservoir (two reservoirs downstream of Chickamauga Reservoir) and similar results were reported (Simmons 2010b). For example, highfin carpsucker, quillback, and smallmouth redhorse were collected only in a few historical cove rotenone samples; the only record of smallmouth redhorse was from 1959 and the only record of highfin carpsucker was from 1951. River carpsucker and bigmouth buffalo records were more numerous, but collections were sporadic; whitetail shiners were collected only by rotenone and in a creek inflow while seining; ghost shiners were collected in rotenone surveys and in a 1974 impingement sample; pugnose minnows and striptail darters were only collected in rotenone samples; banded sculpins and river chubs were never collected; white suckers were only collected in an impingement sample; and rainbow darters were only collected in a stream inflow.

Overall, most species that have not been collected in recent times have never been collected frequently or in large numbers in Chickamauga Reservoir. Some species collected during rotenone surveys are not as susceptible to current sampling gear, thus their presence has not been detected during recent times. Impoundment of the Tennessee River, which eliminated or reduced habitats required for life history aspects such as reproduction and feeding, is the major limiting factor for many of these species. It is evident from TVA tributary stream data that a large portion of fish diversity within the Tennessee River system persists in free-flowing tributaries to reservoirs. Of the 64 species collected in direct tributaries to the Tennessee River within Chickamauga Reservoir, 35 were encountered in electrofishing and gill net sampling conducted during 1993 to 2009 within the reservoir (Table 3). Similarly, of the 91 species collected in the Tennessee portion of the Hiwassee River basin, 51 were encountered in Chickamauga Reservoir during electrofishing and gill netting from 1993 to 2009 (Table 4).

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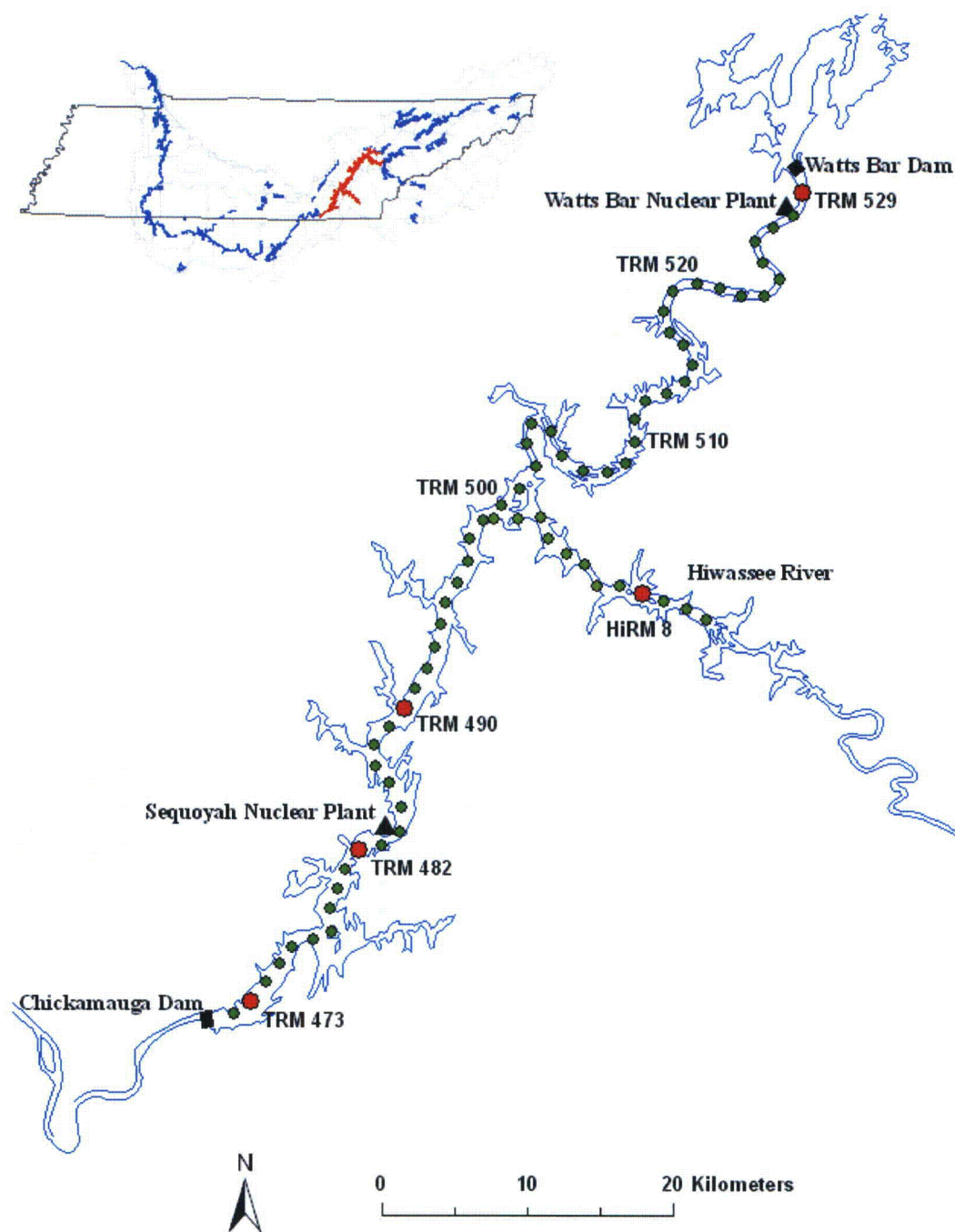


Figure 1. Chickamauga Reservoir, including the Hiwassee River embayment. Red dots indicate the approximate locations of current RFAI fish sampling stations on Chickamauga Reservoir. Green dots indicate Tennessee (TRM) or Hiwassee River Miles (HiRM) for reference and are labeled approximately every 10 river miles.

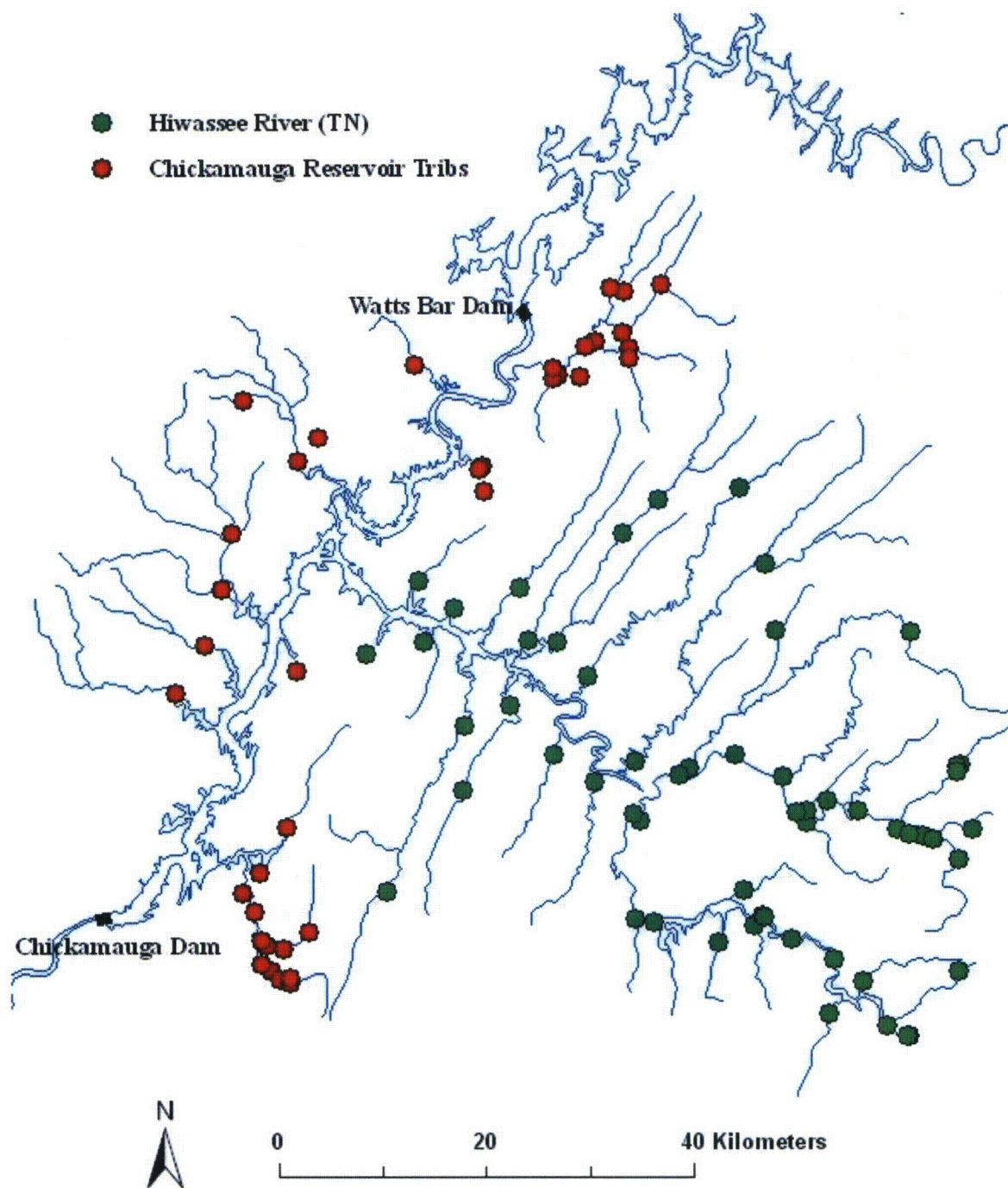


Figure 2. TVA tributary stream and river sampling locations within the Chickamauga Reservoir watershed. Red dots indicate sampling stations on direct tributaries to the Tennessee River (Chickamauga Reservoir). Green dots denote sampling stations on the Tennessee portion of the Hiwassee River and its tributaries.

Table 1. TVA cove rotenone locations and sample years in Chickamauga Reservoir
TRM-Tennessee River mile; HiRM-Hiwassee River

River Mile	Year(s) Sampled
TRM 471.7	1954
TRM 472.8	1949 - 1951
TRM 475	1947, 1950
TRM 472.2	1970
TRM 475.7	1970 - 1976
TRM 476.2	1977 – 1993; 1995, 1997, 1999
TRM 478	1950; 1955 -1957; 1970 – 1993; 1995, 1997, 1999
TRM 483.6	1971
TRM 484.7	1970
TRM 487.5	1950, 1954; 1957 - 1959
TRM 489.6	1952
TRM 492.6	1970
TRM 495	1952; 1970 - 1986
TRM 495.1	1987 – 1993; 1995, 1997, 1999
TRM 505.4	1970
TRM 506	1970
TRM 507.3	1970
TRM 508	1971 – 1993; 1995, 1997, 1999
TRM 524.6	1976 – 1993; 1995, 1997, 1999
HiRM 1.2	1970
HiRM 2.5	1956, 1970
HiRM 3.5	1970

Table 2. A comparison of overall species occurrences from current and historical TVA Chickamauga Reservoir fish collection data from electrofishing (EF), gill netting (GN), hoop netting (HN), trap netting (TN) and cove rotenone surveys, as well as data from fish impingement (impgmt) studies conducted at Sequoyah Nuclear Plant (SQN), Watts Bar Nuclear Plant (WBN), Watts Bar Supplemental Condenser Cooling Water (SCCW), and Watts Bar Steam Plant (WBSP). Records contained in parenthesis were only collected by HN or TN during the specified sampling period/locations. Species are listed alphabetically by common name. Asterisks denote questionable species records.

Data from a special Chickamauga Reservoir embayment study were from Hevel and Hickman (1992). Reservoir Fisheries Assemblage Index (RFAI) data (1993-2009) were from Simmons (2010). Cove rotenone records were taken from raw data files and from Baxter and Gardner (2000). Historic WBN EF, GN, and HN collection records were from TVA (1980) and TVA (1986a). All data included as “WBN” were collected in the vicinity of Watts Bar Nuclear Plant. Historic SQN GN collection records were from TVA (1978); TVA (1982); TVA (1985); TVA (1986b); and TVA (1987). Historic SQN TN records were from TVA (1978). All data included as “SQN” were collected in the vicinity of Sequoyah Nuclear Plant. Gill net data collected during sauger studies during 1986 to 1994 were from Hevel (1987); Hickman et al. (1989); Hickman et al. (1990); Hevel and Hickman (1991); and Hickman and Buchanan (1995). SQN impingement data collected during 1981-1985 were from TVA (1982); TVA (1983); TVA (1985); TVA (1986a). SQN impingement data collected during 2001-2002 were from Kay and Baxter (2002) and data collected during 2005-2007 were from TVA (2007a). WBSP impingement data collected during 1974-1975 were from TVA (1976). WBN impingement data collected from 1996-1997 were from TVA (1998), WBN SCCW impingement data collected from 1999-2000 were from Baxter et al. (2001), and data collected from 2005-2007 were from TVA (2007b).

Common Name	Scientific Name	1991 Embayment Study EF/GN	RFAI EF/GN 1993-2009	Cove Rotenone 1947-1999	WBN EF/GN/HN 1977-1979 1982-1985	SQN GN/TN 1971-1978 GN 1980-1986	Sauger Study GN 1986-1994	SQN Impgmt 1981-1985	SQN Impgmt 2001-2002 2005-2007	WBSP Impgmt 1974-1975	WBN/ SCCW Impgmt 1996-1997 1999-2000 2005-2007
Alewife	<i>Alosa pseudoharengus</i>	---	X	---	---	---	X	---	X	---	---
American eel	<i>Anguilla rostrata</i>	---	---	---	X	---	---	---	---	---	---
Atlantic needlefish	<i>Strongylura marina</i>	---	X	---	---	---	---	---	---	---	---
Banded sculpin	<i>Cottus caroliniae</i>	---	---	---	---	---	---	X	---	---	---
Bigmouth buffalo	<i>Ictiobus cyprinellus</i>	---	---	X	(X)	X	---	---	---	---	---
Black buffalo	<i>Ictiobus niger</i>	X	X	X	---	---	---	---	---	---	---
Black bullhead	<i>Ameiurus melas</i>	---	---	X	X	X	---	---	---	---	---
Black crappie	<i>Pomoxis nigromaculatus</i>	X	X	X	X	X	X	X	X	---	X
Black redhorse	<i>Moxostoma duquesnei</i>	X	X	X	X	---	X	---	---	---	---
Blackspotted topminnow	<i>Fundulus olivaceus</i>	---	---	X	---	---	---	---	---	---	---
Blackstripe topminnow	<i>Fundulus notatus</i>	---	---	X	---	---	---	---	---	---	---
Blue catfish	<i>Ictalurus furcatus</i>	X	X	X	X	X	X	X	X	X	X
Bluegill	<i>Lepomis macrochirus</i>	X	X	X	X	X	X	X	X	X	X
Bluntnose minnow	<i>Pimephales notatus</i>	---	X	X	---	---	---	X	X	---	X
Brook silverside	<i>Labidesthes sicculus</i>	X	X	X	X	---	---	---	---	---	X
Brown bullhead	<i>Ameiurus nebulosus</i>	X	X	X	(X)	X	X	X	---	---	---
Brown trout	<i>Salmo trutta</i>	---	---	---	---	X	---	---	---	---	---
Bullhead minnow	<i>Pimephales vigilax</i>	---	X	X	X	---	---	X	X	X	X
Channel catfish	<i>Ictalurus punctatus</i>	X	X	X	X	X	X	X	X	X	X

Table 2. (Continued)

Common Name	Scientific Name	1991 Embayment Study EF/GN	RFAI EF/GN 1993-2009	Cove Rotenone 1947-1999	WBN EF/GN/HN 1977-1979 1982-1985	SQN GN/TN 1971-1978 GN 1980-1986	Sauger Study GN 1986-1994	SQN Impgmt 1981-1985	SQN Impgmt 2001-2002 2005-2007	WBSP Impgmt 1974-1975	WBN/ SCCW Impgmt 1996-1997 1999-2000 2005-2007
Chestnut lamprey	<i>Ichthyomyzon castaneus</i>	X	X	X	X	X	---	X	---	---	---
Common carp	<i>Cyprinus carpio</i>	X	X	X	X	X	X	X	---	---	---
Dusky darter	<i>Percina sciera</i>	---	X	---	---	---	---	---	---	---	---
Emerald shiner	<i>Notropis atherinoides</i>	X	X	X	X	---	---	X	X	X	---
Fathead minnow	<i>Pimephales promelas</i>	---	---	X	---	---	---	---	---	---	---
Flathead catfish	<i>Pylodictis olivaris</i>	X	X	X	X	X	X	X	X	X	X
Freshwater drum	<i>Aplodinotus grunniens</i>	X	X	X	X	X	X	X	X	X	X
Ghost shiner	<i>Notropis buchanani</i>	---	---	X	---	---	---	---	---	---	---
Gizzard shad	<i>Dorosoma cepedianum</i>	X	X	X	X	X	X	X	X	X	X
Golden redhorse	<i>Moxostoma erythrurum</i>	X	X	X	X	X	X	X	---	---	---
Golden shiner	<i>Notemigonus crysoleucas</i>	X	X	X	X	X	X	X	---	---	---
Goldfish	<i>Carassius auratus</i>	---	---	X	---	X	---	---	---	---	---
Grass carp	<i>Ctenopharyngodon idella</i>	---	X	---	---	---	---	---	---	---	---
Green sunfish	<i>Lepomis cyanellus</i>	X	X	X	X	X	---	X	---	---	---
Highfin carpsucker	<i>Carpionodes velifer</i>	---	X	X	X	---	---	---	---	---	---
Inland silverside	<i>Menidia beryllina</i>	---	X	---	---	---	---	---	---	---	---
Lake sturgeon	<i>Acipenser fulvescens</i>	---	X	---	---	---	---	---	---	---	---
Largemouth bass	<i>Micropterus salmoides</i>	X	X	X	X	X	X	X	X	---	X
Largescale stoneroller	<i>Camptostoma oligolepis</i>	---	X	X	---	---	---	---	---	---	---
Logperch	<i>Percina caprodes</i>	X	X	X	X	---	---	X	X	X	X
Longear sunfish	<i>Lepomis megalotis</i>	X	X	X	X	X	---	X	---	---	X
Longnose gar	<i>Lepisosteus osseus</i>	X	X	X	X	X	X	---	---	---	---
Mimic shiner	<i>Notropis volucellus</i>	---	---	X	---	---	---	X	---	---	---
Mooneye	<i>Hiodon tergisus</i>	X	X	X	X	X	X	X	---	X	---
Mud darter*	<i>Etheostoma asprigene*</i>	---	---	X	---	---	---	---	---	---	---
Northern hogsucker	<i>Hypentelium nigricans</i>	---	X	X	X	X	X	---	---	---	---
Orangespotted sunfish	<i>Lepomis humilis</i>	---	---	X	---	X	---	---	---	---	---
Orangethroat darter*	<i>Etheostoma spectabile*</i>	---	---	X	---	---	---	---	---	---	---
Paddlefish	<i>Polyodon spathula</i>	---	---	X	X	X	X	---	---	---	---
Pugnose minnow	<i>Opsopoeodus emiliae</i>	---	---	X	---	---	---	---	---	---	---
Pumpkinseed*	<i>Lepomis gibbosus*</i>	---	---	---	---	X	---	---	---	---	---
Quillback	<i>Carpionodes cyprinus</i>	X	---	X	X	X	X	---	---	---	---
Rainbow darter	<i>Etheostoma caeruleum</i>	---	---	X	---	---	---	---	---	---	---
Rainbow trout	<i>Oncorhynchus mykiss</i>	---	---	---	X	---	X	X	---	---	---
Redbreast sunfish	<i>Lepomis auritus</i>	X	X	X	X	X	---	X	X	---	X

Table 2. (Continued)

Common Name	Scientific Name	1991 Embayment Study EF/GN	RFAI EF/GN 1993-2009	Cove Rotenone 1947-1999	WBN EF/GN/HN 1977-1979 1982-1985	SNQ GN/TN 1971-1978 GN 1980-1986	Sauger Study GN 1986-1994	SNQ Impgmt 1981-1985	SNQ Impgmt 2001-2002 2005-2007	WBSP Impgmt 1974-1975	WBN/ SCCW Impgmt 1996-1997 1999-2000 2005-2007
Redear sunfish	<i>Lepomis microlophus</i>	X	X	X	X	X	X	X	X	X	X
River carpsucker	<i>Carpionodes carpio</i>	X	X	X	X	X	X	---	---	---	---
River chub	<i>Nocomis micropogon</i>	---	---	---	---	---	---	X	---	---	---
River redhorse	<i>Moxostoma carinatum</i>	X	X	X	X	X	---	---	---	---	---
Rock bass	<i>Ambloplites rupestris</i>	---	X	X	X	X	X	X	---	---	---
Sauger	<i>Sander canadensis</i>	X	X	X	X	X	X	X	X	---	---
Sawfin shiner*	<i>Notropis sp.*</i> (undescribed)	---	---	---	---	---	---	X	---	---	---
Shortnose gar*	<i>Lepisosteus platostomus*</i>	X	---	X	X	X	X	---	---	---	---
Silver chub	<i>Macrhybopsis storeriana</i>	---	---	X	X	---	---	X	---	---	---
Silver redhorse	<i>Moxostoma anisurum</i>	X	X	X	X	---	X	---	---	---	---
Skipjack herring	<i>Alosa chrysochloris</i>	X	X	X	X	X	X	X	X	X	X
Smallmouth bass	<i>Micropterus dolomieu</i>	X	X	X	X	X	X	---	---	X	---
Smallmouth buffalo	<i>Ictiobus bubalus</i>	X	X	X	X	X	X	---	---	X	---
Smallmouth redhorse	<i>Moxostoma breviceps</i>	---	X	X	X	(X)	X	---	---	---	---
Spotfin shiner	<i>Cyprinella spiloptera</i>	X	X	X	X	---	---	X	---	---	X
Spotted bass	<i>Micropterus punctulatus</i>	X	X	X	X	X	X	X	X	---	X
Spotted gar	<i>Lepisosteus oculatus</i>	X	X	X	X	X	X	---	---	---	---
Spotted sucker	<i>Minytrema melanops</i>	X	X	X	X	X	X	X	---	---	---
Steelcolor shiner	<i>Cyprinella whipplei</i>	X	X	X	---	---	---	---	---	X	---
Striped bass	<i>Morone saxatilis</i>	X	X	X	X	X	X	X	X	X	X
Striped shiner	<i>Luxilus chrysocephalus</i>	---	X	X	---	---	---	X	---	---	---
Stripetail darter	<i>Etheostoma kennicotti</i>	---	---	X	---	---	---	---	---	---	---
Tangerine darter	<i>Percina aurantiaca</i>	---	---	---	---	---	---	---	---	---	X
Threadfin shad	<i>Dorosoma petenense</i>	X	X	X	X	X	X	X	X	X	X
Walleye	<i>Sander vitreus</i>	---	X	---	X	X	X	---	---	---	---
Warmouth	<i>Lepomis gulosus</i>	X	X	X	X	X	X	X	---	---	X
Western mosquitofish	<i>Gambusia affinis</i>	---	X	X	---	---	---	X	X	---	---
White bass	<i>Morone chrysops</i>	X	X	X	X	X	X	X	X	X	X
White crappie	<i>Pomoxis annularis</i>	X	X	X	X	X	X	X	X	X	X
Whitetail shiner	<i>Cyprinella galactura</i>	---	---	X	---	---	---	---	---	---	---
White sucker	<i>Catostomus commersoni</i>	X	---	X	X	X	X	---	---	---	---
Yellow bass	<i>Morone mississippiensis</i>	X	X	X	X	X	X	X	X	X	X
Yellow bullhead	<i>Ameiurus natalis</i>	X	X	X	X	X	---	X	X	---	---
Yellow perch	<i>Perca flavescens</i>	X	X	X	X	X	X	X	---	---	X
	Total number of species:	47	60	73	57	50	42	44	25	20	26

Table 3. Fish species collected during TVA stream sampling in direct tributaries to the Tennessee River within Chickamauga Reservoir, 1995-2009. No sampling was conducted during 2010. Species are listed alphabetically by common name.

Year(s) Collected	Common Name	Scientific name	Collected in 1993-2009 RFAI Samples
1995-2007	American brook lamprey	<i>Lampetra appendix</i>	---
1995	Banded darter	<i>Etheostoma zonale</i>	---
1995-2009	Banded sculpin	<i>Cottus carolinae</i>	---
1995-2008	Bigeye chub	<i>Hybopsis amblops</i>	---
1995-2007	Black bullhead	<i>Ameiurus melas</i>	---
1995-2009	Black crappie	<i>Pomoxis nigromaculatus</i>	X
1995-2008	Black redhorse	<i>Moxostoma duquesnei</i>	X
1995-2009	Blackside snubnose darter	<i>Etheostoma duryi</i>	---
1995-2009	Blackspotted topminnow	<i>Fundulus olivaceus</i>	---
1999	Blackstripe topminnow	<i>Fundulus notatus</i>	---
1995-2009	Bluegill	<i>Lepomis macrochirus</i>	X
1995-2008	Blueside darter	<i>Etheostoma jessiae</i>	---
1995-2009	Bluntnose minnow	<i>Pimephales notatus</i>	X
1995-2005	Brook silverside	<i>Labidesthes sicculus</i>	X
1999	Bullhead minnow	<i>Pimephales vigilax</i>	X
1999-2003	Channel catfish	<i>Ictalurus punctatus</i>	X
1995	Chestnut lamprey	<i>Ichthyomyzon castaneus</i>	X
1995-2008	Creek chub	<i>Semotilus atromaculatus</i>	---
1995-1999	Dusky darter	<i>Percina sciera</i>	X
1995-2003	Emerald shiner	<i>Notropis atherinoides</i>	X
1995-2008	Fantail darter	<i>Etheostoma flabellare</i>	---
1999-2008	Fathead minnow	<i>Pimephales promelas</i>	---
1999-2009	Freshwater drum	<i>Aplodinotus grunniens</i>	X
1999-2009	Gizzard shad	<i>Dorosoma cepedianum</i>	X
1995-2009	Golden redhorse	<i>Moxostoma erythrurum</i>	X
1995-2009	Golden shiner	<i>Notemigonus crysoleucas</i>	X
1996	Goldfish	<i>Carassius auratus</i>	---
1995-2009	Green sunfish	<i>Lepomis cyanellus</i>	X
1995-2008	Greenside darter	<i>Etheostoma blennioides</i>	---
1995-2009	Largemouth bass	<i>Micropterus salmoides</i>	X
1995-2009	Largescale stoneroller	<i>Campostoma oligolepis</i>	X
1995-2009	Logperch	<i>Percina caprodes</i>	X
1995-2009	Longear sunfish	<i>Lepomis megalotis</i>	X
2007	Longnose gar	<i>Lepisosteus osseus</i>	X
1999-2004	Mottled sculpin	<i>Cottus bairdii</i>	---
1995-2005	Mountain shiner	<i>Lythrurus lirus</i>	---
1995-2008	Northern hogsucker	<i>Hypentelium nigricans</i>	X
1995-2008	Northern studfish	<i>Fundulus catenatus</i>	---

Table 3. (Continued)

Year(s) Collected	Common Name	Scientific name	Collected in 1993-2009 RFAI Samples
1995-2009	Rainbow darter	<i>Etheostoma caeruleum</i>	---
1996-2005	Rainbow trout	<i>Oncorhynchus mykiss</i>	---
1995-2009	Redbreast sunfish	<i>Lepomis auritus</i>	X
1995-2009	Redear sunfish	<i>Lepomis microlophus</i>	X
1995-2009	Redline darter	<i>Etheostoma rufilineatum</i>	---
2004	River chub	<i>Nocomis micropogon</i>	---
1995-2008	Rock bass	<i>Ambloplites rupestris</i>	X
1996	Scarlet shiner	<i>Lythrurus fasciolaris</i>	---
2008	Silver redhorse	<i>Moxostoma anisurum</i>	X
1995-2008	Smallmouth bass	<i>Micropterus dolomieu</i>	X
1995-2009	Snubnose darter	<i>Etheostoma simoterum</i>	---
1995-2009	Spotfin shiner	<i>Cyprinella spiloptera</i>	X
1995-2008	Spotted bass	<i>Micropterus punctulatus</i>	X
1995-2009	Spotted sucker	<i>Minytrema melanops</i>	X
1996-2005	Steelcolor shiner	<i>Cyprinella whipplei</i>	X
1995-2009	Striped shiner	<i>Luxilus chrysocephalus</i>	X
2002-2007	Stripetail darter	<i>Etheostoma kennicotti</i>	---
1995-2003	Telescope shiner	<i>Notropis telescopus</i>	---
1995-2009	Warmouth	<i>Lepomis gulosus</i>	X
1995-2008	Warpaint shiner	<i>Luxilus coccogenis</i>	---
1995-2008	Western blacknose dace	<i>Rhinichthys obtusus</i>	---
1995-2009	Western mosquitofish	<i>Gambusia affinis</i>	X
1995-2009	White sucker	<i>Catostomus commersoni</i>	---
1995-2008	Whitetail shiner	<i>Cyprinella galactura</i>	---
1995-2007	Yellow bullhead	<i>Ameiurus natalis</i>	X
1996-2008	Yellow perch	<i>Perca flavescens</i>	X
Total number of species			64
Total number collected both in tributary streams and in RFAI samples			35 (55%)

Table 4. Fish species collected during TVA stream and river sampling in the Tennessee portion of the Hiwassee River and its tributaries, 1991-2010. Species are listed alphabetically by common name.

Year(s) Collected	Common Name	Scientific name	Collected in 1993-2009 RFAI Samples
1991-2009	American brook lamprey	<i>Lampetra appendix</i>	---
1991-2010	Banded darter	<i>Etheostoma zonale</i>	---
1993-2010	Banded sculpin	<i>Cottus carolinae</i>	---
1993-2010	Bigeye chub	<i>Hybopsis amblops</i>	---
1992-2009	Black buffalo	<i>Ictiobus niger</i>	X
2003, 2008	Black bullhead	<i>Ameiurus melas</i>	---
1992-2010	Black crappie	<i>Pomoxis nigromaculatus</i>	X
1991-2010	Black redhorse	<i>Moxostoma duquesnei</i>	X
1999-2007	Blackside snubnose darter	<i>Etheostoma duryi</i>	---
1993-2010	Blackspotted topminnow	<i>Fundulus olivaceus</i>	---
1993	Blackstripe topminnow	<i>Fundulus notatus</i>	---
2009	Blueback herring	<i>Alosa aestivalis</i>	---
1993-2007	Bluebreast darter	<i>Etheostoma camurum</i>	---
1991-2010	Bluegill	<i>Lepomis macrochirus</i>	X
1993-2008	Blueside darter	<i>Etheostoma jessiae</i>	---
1995-2009	Bluntnose minnow	<i>Pimephales notatus</i>	X
1993-2010	Brook silverside	<i>Labidesthes sicculus</i>	X
1994-2007	Brown bullhead	<i>Ameiurus nebulosus</i>	X
1991-2009	Brown trout	<i>Salmo trutta</i>	---
1991-2010	Central stoneroller	<i>Campostoma anomalum</i>	---
1991-2010	Channel catfish	<i>Ictalurus punctatus</i>	X
1991-2010	Chestnut lamprey	<i>Ichthyomyzon castaneus</i>	X
1992-2001	Common carp	<i>Cyprinus carpio</i>	X
1993-2010	Creek chub	<i>Semotilus atromaculatus</i>	---
1993-2010	Dusky darter	<i>Percina sciera</i>	X
1993-2007	Emerald shiner	<i>Notropis atherinoides</i>	X
1993-2008	Fathead minnow	<i>Pimephales promelas</i>	---
1995	Flame chub	<i>Hemitremia flammea</i>	---
1993-2009	Flathead catfish	<i>Pylodictis olivaris</i>	X
1991-2010	Freshwater drum	<i>Aplodinotus grunniens</i>	X
1991-2010	Gilt darter	<i>Percina evides</i>	---
1991-2010	Gizzard shad	<i>Dorosoma cepedianum</i>	X
1991-2010	Golden redhorse	<i>Moxostoma erythrurum</i>	X
1993-2008	Golden shiner	<i>Notemigonus crysoleucas</i>	X
1991-2010	Green sunfish	<i>Lepomis cyanellus</i>	X
1991-2010	Greenside darter	<i>Etheostoma blennioides</i>	---
1991-2010	Largemouth bass	<i>Micropterus salmoides</i>	X

Table 4. (Continued)

Year(s) Collected	Common Name	Scientific name	Collected in 1993-2009 RFAI Samples
2001-2009	Largescale stoneroller	<i>Campostoma oligolepis</i>	X
2006, 2008	Least brook lamprey	<i>Lampetra aepyptera</i>	---
1991-2010	Logperch	<i>Percina caprodes</i>	X
1993-2010	Longear sunfish	<i>Lepomis megalotis</i>	X
1993-2010	Longnose gar	<i>Lepisosteus osseus</i>	X
1991-2010	Mirror shiner	<i>Notropis spectrunculus</i>	---
1992-2007	Mooneye	<i>Hiodon tergisus</i>	X
1991-2010	Mottled sculpin	<i>Cottus bairdii</i>	---
1993-2010	Mountain brook lamprey	<i>Ichthyomyzon greeleyi</i>	---
1995-2006	Mountain shiner	<i>Lythrurus lirus</i>	---
1991-2010	Northern hogsucker	<i>Hypentelium nigricans</i>	X
1999-2008	Northern studfish	<i>Fundulus catenatus</i>	---
1991-2009	Ohio lamprey	<i>Ichthyomyzon bdellium</i>	---
1995-2001	Olive darter	<i>Percina squamata</i>	---
1993-2007	Quillback	<i>Carpiodes cyprinus</i>	---
1995-2008	Rainbow darter	<i>Etheostoma caeruleum</i>	---
1991-2010	Rainbow trout	<i>Oncorhynchus mykiss</i>	---
1991-2010	Redbreast sunfish	<i>Lepomis auritus</i>	X
1991-2010	Redear sunfish	<i>Lepomis microlophus</i>	X
1991-2010	Redline darter	<i>Etheostoma rufilineatum</i>	---
1999, 2005	River carpsucker	<i>Carpiodes carpio</i>	X
1991-2010	River chub	<i>Nocomis micropogon</i>	---
1991-2009	River redhorse	<i>Moxostoma carinatum</i>	X
1991-2010	Rock bass	<i>Ambloplites rupestris</i>	X
1991-2010	Sauger	<i>Sander canadense</i>	X
1992-2009	Silver redhorse	<i>Moxostoma anisurum</i>	X
1993-2009	Smallmouth bass	<i>Micropterus dolomieu</i>	X
1991-2009	Smallmouth buffalo	<i>Ictiobus bubalus</i>	X
1991-2009	Smallmouth redhorse	<i>Moxostoma breviceps</i>	X
1991-2009	Snail darter	<i>Percina tanasi</i>	---
1991-2010	Snubnose darter	<i>Etheostoma simoterum</i>	---
1993-2010	Spotfin shiner	<i>Cyprinella spiloptera</i>	X
1991-2010	Spotted bass	<i>Micropterus punctulatus</i>	X
2005	Spotted gar	<i>Lepisosteus oculatus</i>	X
1991-2010	Spotted sucker	<i>Minytrema melanops</i>	X
1993-2008	Steelcolor shiner	<i>Cyprinella whipplei</i>	X
1991-2010	Striped bass	<i>Morone saxatilis</i>	X
1991-2010	Striped shiner	<i>Luxilus chrysocephalus</i>	X
1993-2009	Tangerine darter	<i>Percina aurantiaca</i>	---

Table 4. (Continued)

Year(s) Collected	Common Name	Scientific name	Collected in 1993-2009 RFAI Samples
1991-2009	Telescope shiner	<i>Notropis telescopus</i>	---
1991-2010	Tennessee shiner	<i>Notropis leuciodus</i>	---
1993-2006	Threadfin shad	<i>Dorosoma petenense</i>	X
1999, 2001	Walleye	<i>Sander vitreum</i>	X
1993-2010	Warmouth	<i>Lepomis gulosus</i>	X
1991-2010	Warpaint shiner	<i>Luxilus coccogenis</i>	---
1993-2010	Western blacknose dace	<i>Rhinichthys obtusus</i>	---
1993-2010	Western mosquitofish	<i>Gambusia affinis</i>	X
1991-2008	White bass	<i>Morone chrysops</i>	X
1994-2010	White crappie	<i>Pomoxis annularis</i>	X
1993-2008	White sucker	<i>Catostomus commersoni</i>	---
1991-2010	Whitetail shiner	<i>Cyprinella galactura</i>	---
1991-2010	Yellow bass	<i>Morone mississippiensis</i>	X
1993-2010	Yellow bullhead	<i>Ameiurus natalis</i>	X
1991-2010	Yellow perch	<i>Perca flavescens</i>	X
Total number of species			91
Total number collected both in the Hiwassee River and its tributaries and in RFAI samples			51 (56%)

Appendix 1. Fish species collected, by year, from 1947 to 1999 in TVA cove rotenone surveys, Chickamauga Reservoir. Tennessee River Mile (TRM) and Hiwassee River Mile (HiRM) ranges are reservoir segments where sampling occurred in various coves throughout that particular river reach. Fish species are listed in alphabetical order by common name. *1999 Cove rotenone records are from Baxter and Gardner (2000). Exact cove locations for 1999 species records were not specified and are listed in the TRM 471.7-478 column. 1999 samples were collected in coves near TRM 476.2, 478, 495.1, 508, and 524.6. **Denotes questionable species records.

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Bigmouth buffalo	<i>Ictiobus cyprinellus</i>	1947 1970 1975	1950 1957		1970		1978
Black buffalo	<i>Ictiobus niger</i>	1955 1971 1999*	1957 1970 1971			1971	1986 1989 1997
Black bullhead	<i>Ameiurus melas</i>	1981		1979 1983		1972 1981 1982 1983	1983 1993
Black crappie	<i>Pomoxis nigromaculatus</i>	1950 1954 1972 1979 1980 1981 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1999*	1959	1952 1970 1977 1979 1980 1981 1985 1988 1989 1990 1991 1992 1993 1995 1997	1956	1980 1981 1985 1988 1989 1990 1991 1992 1993 1995 1997	1986 1987 1988 1989 1990 1991 1992 1993 1995 1997
Black redbreast	<i>Moxostoma valenciennesi</i>	1955 1956		1970 1972		1972 1976	1979

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Black redhorse (Continued)	<i>Moxostoma duquesnei</i>	1976 1999*		1976 1977 1980 1986		1982	
Blackspotted topminnow	<i>Fundulus olivaceus</i>	1973 1974 1977 1978 1993 1999*		1974 1975 1976 1977 1978 1979 1980 1982 1983 1984 1985 1986 1995 1997			
Blackstripe topminnow	<i>Fundulus notatus</i>			1976 1981		1972	
Blue catfish	<i>Ictalurus furcatus</i>	1947 1950 1951 1954 1955 1956 1957 1972 1973 1975 1980 1992 1999*	1954 1957 1958 1959 1971	1952 1978 1980	1970	1972 1978	1976 1980
Bluegill	<i>Lepomis macrochirus</i>	1947 1949 1950	1950 1954 1957	1952 1970 1971	1956 1970	1970 1971 1972	1976 1977 1978

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Bluegill (Continued)	<i>Lepomis macrochirus</i>	1951	1958	1972		1973	1979
		1954	1959	1973		1974	1980
		1955	1970	1974		1975	1981
		1957	1971	1975		1976	1982
		1970		1976		1977	1983
		1971		1977		1978	1984
		1972		1978		1979	1985
		1973		1979		1980	1986
		1974		1980		1981	1987
		1975		1981		1982	1988
		1976		1982		1983	1989
		1977		1983		1984	1990
		1978		1984		1985	1991
		1979		1985		1986	1992
		1980		1986		1987	1993
		1981		1987		1988	1995
		1982		1988		1989	1997
		1983		1989		1990	
		1984		1990		1991	
		1985		1991		1992	
		1986		1992		1993	
		1987		1993		1995	
		1988		1995		1997	
		1989		1997			
		1990					
		1991					
		1992					
		1993					
		1995					
		1997					
		1999*					
Bluntnose minnow	<i>Pimephales notatus</i>	1949		1972		1991	1988
		1972		1993		1992	1989
		1976		1995		1993	1990
		1981		1997		1995	1993
		1984				1997	1995
		1997					
		1999*					
Brook silverside	<i>Labidesthes sicculus</i>	1949	1954	1971	1956	1971	1976
		1950	1958	1972		1972	1977
		1954		1973		1973	1981

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Brook silverside (Continued)	<i>Labidesthes sicculus</i>	1956		1974		1975	1982
		1971		1975		1976	1983
		1972		1976		1977	1984
		1973		1977		1978	1986
		1974		1978		1979	1987
		1975		1979		1980	1988
		1976		1980		1981	1989
		1977		1981		1982	1990
		1978		1982		1983	1991
		1979		1983		1984	1992
		1980		1984		1985	1993
		1981		1985		1986	1995
		1982		1986		1987	
		1983		1987		1988	
		1984		1988		1989	
		1985		1989		1990	
		1986		1990		1991	
		1987		1991		1992	
		1988		1992		1993	
		1989		1993		1995	
		1990		1995		1997	
		1991		1997			
		1992					
		1993					
		1995					
		1997					
		1999*					
Brown bullhead	<i>Ameiurus nebulosus</i>	1982		1985		1983	1983
		1984		1986		1986	1987
		1985		1987		1989	1988
		1986		1988		1991	1989
		1987		1990		1993	1990
		1988				1995	1991
		1989					1992
		1990					1993
		1999*					1995
							1997
Bullhead minnow	<i>Pimephales vigilax</i>	1950	1957	1971		1971	1976
		1951	1971	1974		1972	1977
		1957		1975		1974	1980
		1971		1976		1975	1981

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Bullhead minnow (Continued)	<i>Pimephales vigilax</i>	1973		1977		1976	1982
		1974		1978		1977	1983
		1975		1979		1978	1984
		1976		1980		1979	1985
		1977		1982		1980	1986
		1978		1984		1982	1987
		1979		1985		1983	1988
		1980		1986		1984	1989
		1981		1987		1985	1990
		1982		1990		1986	1991
		1983		1991		1987	1992
		1984		1992		1988	1993
		1985		1993		1989	1995
		1986		1995		1990	1997
		1987		1997		1991	
		1988				1992	
		1989				1993	
		1990				1995	
		1991				1997	
		1992					
		1993					
		1995					
		1997					
		1999*					
Channel catfish	<i>Ictalurus punctatus</i>	1947	1950	1952	1956	1970	1976
		1949	1954	1970	1970	1971	1977
		1950	1957	1971		1972	1978
		1951	1958	1972		1973	1979
		1954	1959	1974		1974	1980
		1955	1971	1975		1975	1981
		1956		1976		1976	1982
		1957		1977		1977	1983
		1970		1978		1978	1985
		1971		1979		1979	1986
		1972		1980		1981	1987
		1973		1981		1982	1988
		1974		1983		1983	1989
		1975		1984		1984	1990
		1976		1985		1985	1991
		1977		1988		1987	1992
		1978		1990		1988	1993
		1979		1991		1989	1997

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Channel catfish (Continued)	<i>Ictalurus punctatus</i>	1980				1990	
		1981				1991	
		1982				1992	
		1983				1993	
		1984				1997	
		1985					
		1986					
		1987					
		1988					
		1989					
		1990					
		1991					
		1992					
		1993					
		1997					
		1999*					
Chestnut lamprey	<i>Ichthyomyzon castaneus</i>	1950		1981		1984	
		1995					
		1999*					
Common carp	<i>Cyprinus carpio</i>	1947	1954	1952	1956	1970	1976
		1950	1959	1971	1970	1971	1977
		1951	1970	1972		1972	1978
		1954	1971	1973		1973	1979
		1956		1974		1974	1980
		1957		1977		1975	1981
		1970		1978		1976	1982
		1971		1979		1977	1983
		1972		1980		1978	1985
		1973		1981		1979	1986
		1974		1982		1980	1987
		1975		1983		1981	1988
		1976		1984		1982	1989
		1978		1985		1983	1990
		1979		1986		1984	1991
		1980		1988		1985	1992
		1981				1986	
		1982				1987	
		1984				1988	
		1985				1991	
		1986					
		1987					

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Common Carp (Continued)	<i>Cyprinus carpio</i>	1989 1990 1991 1992 1999*					
Emerald shiner	<i>Notropis atherinoides</i>	1950 1972 1973 1974 1975 1976 1977 1978 1979 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1995 1997 1999*	1971	1972 1974 1975 1976 1977 1979 1980 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1995 1997		1972 1977 1978 1979 1980 1982 1983 1985 1986 1987 1988 1989 1991 1992 1995 1997	1977 1978 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1993 1995 1997
Fathead minnow	<i>Pimephales promelas</i>			1979			
Flathead catfish	<i>Pylodictis olivaris</i>	1949 1950 1951 1954 1955 1957 1970 1971 1972	1954 1957 1958 1959 1970 1971	1952 1970 1971 1972 1973 1974 1975 1976 1977	1956 1970	1970 1971 1972 1973 1974 1975 1976 1977 1978	1976 1977 1991

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Flathead catfish (Continued)	<i>Pylodictis olivaris</i>	1973		1978		1982	
		1974		1979		1986	
		1975		1980		1989	
		1976		1981		1990	
		1977		1982		1991	
		1978		1983		1992	
		1979		1988		1997	
		1980		1989			
		1981		1990			
		1985		1992			
		1986		1993			
		1987		1995			
		1989					
		1990					
		1991					
		1992					
		1993					
		1995					
		1997					
		1999*					
Freshwater drum	<i>Aplodinotus grunniens</i>	1949	1950	1952	1956	1970	1976
		1950	1954	1970	1970	1971	1977
		1951	1957	1971		1972	1978
		1954	1958	1972		1973	1979
		1955	1959	1973		1974	1980
		1956	1970	1974		1975	1981
		1957	1971	1975		1976	1982
		1970		1976		1977	1983
		1971		1977		1978	1984
		1972		1978		1979	1985
		1973		1979		1980	1986
		1974		1980		1981	1987
		1975		1981		1982	1988
		1976		1982		1983	1989
		1977		1983		1984	1990
		1978		1984		1985	1991
		1979		1985		1986	1992
		1980		1986		1987	1993
		1981		1987		1988	1995
		1982		1988		1989	1997
		1983		1989		1990	

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Freshwater drum (Continued)	<i>Aplodinotus grunniens</i>	1984		1990		1991	
		1985		1991		1992	
		1986		1992		1993	
		1987		1993		1995	
		1988		1995		1997	
		1989		1997			
		1990					
		1991					
		1992					
		1993					
		1995					
		1997					
		1999*					
Ghost shiner	<i>Notropis buechanani</i>	1982		1974		1988	1986
		1987		1986		1997	1988
		1992					
		1995					
		1997					
		1999*					
Gizzard shad	<i>Dorosoma cepedianum</i>	1947	1950	1952	1956	1970	1976
		1949	1954	1970	1970	1971	1977
		1950	1957	1972		1972	1978
		1951	1958	1973		1973	1979
		1954	1959	1974		1974	1980
		1955	1970	1975		1975	1981
		1956	1971	1976		1976	1982
		1957		1977		1977	1983
		1970		1978		1978	1984
		1971		1979		1979	1985
		1972		1980		1980	1986
		1973		1981		1981	1987
		1974		1982		1982	1988
		1975		1983		1983	1989
		1976		1984		1984	1990
		1977		1985		1985	1991
		1978		1986		1986	1992
		1979		1987		1987	1993
		1980		1988		1988	1995
		1981		1989		1989	1997
		1982		1990		1990	
		1983		1991		1991	

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Gizzard shad (Continued)	<i>Dorosoma cepedianum</i>	1984		1992		1992	
		1985		1993		1993	
		1986		1995		1995	
		1987		1997		1997	
		1988					
		1989					
		1990					
		1991					
		1992					
		1993					
		1995					
		1997					
		1999*					
Golden redhorse (Continued)	<i>Moxostoma erythrurum</i>	1951	1959	1970	1970	1970	1976
		1955		1974		1971	1979
		1956		1975		1972	1990
		1957		1977		1973	
		1970		1979		1974	
		1971		1984		1976	
		1972		1989		1977	
		1973		1990		1980	
		1974		1995		1981	
		1975		1997		1985	
		1977				1986	
		1978				1989	
		1979				1990	
		1980				1992	
		1983					
		1991					
		1995					
		1997					
		1999*					
Golden shiner	<i>Notemigonus crysoleucas</i>	1973	1971	1976	1970	1971	1976
		1975		1977		1972	1977
		1976		1978		1973	1978
		1977		1979		1974	1980
		1978		1980		1975	1981
		1979		1981		1976	1982
		1980		1982		1977	1983
		1981		1983		1978	1984
		1982		1984		1979	1985

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Golden shiner (Continued)	<i>Notemigonus crysoleucas</i>	1983		1985		1980	1986
		1984		1986		1981	1987
		1985		1987		1982	1988
		1986		1988		1983	1989
		1987		1989		1984	1990
		1988		1990		1985	1991
		1989		1991		1986	1992
		1990		1992		1987	1993
		1991		1993		1988	1995
		1992		1995		1989	1997
		1993		1997		1990	
		1995				1991	
		1997				1992	
		1999*				1993	
						1995	
						1997	
Goldfish	<i>Carassius auratus</i>	1954		1979	1970		
		1956					
		1999*					
Green sunfish	<i>Lepomis cyanellus</i>	1949	1950	1952	1970	1970	1977
		1950	1957	1970		1971	1979
		1951	1958	1971		1972	1980
		1954	1959	1973		1973	1982
		1956	1970	1977		1975	1983
		1957		1978		1976	1984
		1970		1979		1977	1985
		1971		1980		1979	1987
		1972		1981		1980	1988
		1973		1982		1981	1989
		1974		1983		1982	1990
		1976		1984		1983	1991
		1977		1986		1984	1993
		1978		1987		1987	1995
		1979		1989		1988	1997
		1980		1990		1989	
		1981		1991		1990	
		1982		1993		1991	
		1983		1995		1992	
		1984		1997		1993	
		1985				1995	
		1986				1997	
		1987					

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Green sunfish (Continued)	<i>Lepomis cyanellus</i>	1988					
		1989					
		1990					
		1991					
		1992					
		1993					
		1995					
		1997					
		1999*					
Highfin carpsucker	<i>Carpiodes velifer</i>	1949					
Largemouth bass	<i>Micropterus salmoides</i>	1947	1950	1952	1956	1970	1976
		1949	1954	1970	1970	1971	1977
		1950	1957	1971		1972	1978
		1951	1958	1972		1973	1979
		1954	1959	1973		1974	1980
		1955	1970	1974		1975	1982
		1956	1971	1975		1976	1983
		1957		1976		1977	1984
		1970		1977		1978	1985
		1971		1978		1979	1986
		1972		1979		1980	1987
		1973		1980		1981	1988
		1974		1981		1982	1989
		1975		1982		1983	1990
		1976		1983		1984	1991
		1977		1984		1985	1992
		1978		1985		1986	1993
		1979		1986		1987	1995
		1980		1987		1988	1997
		1981		1988		1989	
		1982		1989		1990	
		1983		1990		1991	
		1984		1991		1992	
		1985		1992		1993	
		1986		1993		1995	
		1987		1995		1997	
		1988		1997			
		1989					
		1990					
		1991					
		1992					

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Largemouth bass (Continued)	<i>Micropterus salmoides</i>	1993 1995 1997 1999*					
Largescale stoneroller	<i>Campostoma oligolepis</i>	1950 1973 1976 1977 1978 1980 1997 1999*		1974 1976 1977 1978 1979 1980 1983 1984 1990 1992 1993 1997		1978 1980 1982 1995	1988
Logperch	<i>Percina caprodes</i>	1950 1954 1956 1957 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991	1954 1957 1958	1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1995	1956	1971 1972 1973 1976 1977 1978 1980 1984 1986 1988 1989 1990 1991 1992 1993 1995 1997	1984

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Logperch (continued)	<i>Percina caprodes</i>	1992		1997			
		1993					
		1995					
		1997					
		1999*					
Longear sunfish	<i>Lepomis megalotis</i>	1949	1950	1952		1970	1983
		1951	1954	1970		1972	1985
		1954	1958	1971		1973	1989
		1970	1959	1972		1977	1990
		1971	1970	1973		1978	1991
		1972	1971	1974		1980	1992
		1973		1975		1982	1997
		1974		1976		1984	
		1975		1977		1985	
		1976		1978		1986	
		1977		1979		1987	
		1978		1980		1989	
		1979		1981		1993	
		1980		1982			
		1981		1984			
		1982		1985			
		1983		1986			
		1984		1987			
		1985		1989			
		1986		1990			
		1987					
		1988					
		1989					
		1990					
		1991					
		1992					
		1993					
		1995					
		1997					
		1999*					
Longnose gar	<i>Lepisosteus osseus</i>	1950	1971	1970		1978	1977
		1970		1978		1979	1978
		1972		1980		1980	1979
		1975		1981		1982	1980
		1976		1984		1983	1982
		1978		1985		1984	1983

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Longnose gar (Continued)	<i>Lepisosteus osseus</i>	1979		1988		1985	1989
		1980		1990		1988	1990
		1982		1992		1990	1997
		1983		1995		1992	
		1984				1993	
		1987				1997	
		1988					
		1993					
		1997					
		1999*					
Mimic shiner	<i>Notropis volucellus</i>	1976		1976		1977	1977
		1977					1984
		1978					
Mooneye	<i>Hiodon tergisus</i>	1949	1954	1952	1970	1970	
		1950	1957	1973		1973	
		1955	1958	1974		1977	
		1956	1959				
		1957					
		1970					
		1976					
Mud darter**	<i>Etheostoma asprigene</i>	1972					
Northern hogsucker	<i>Hypentelium nigricans</i>	1950	1954	1971			
		1955	1957	1972			
		1972		1976			
		1973		1977			
		1975					
		1976					
		1978					
		1979					
		1980					
		1986					
		1993					
		1999*					
Orangespotted sunfish	<i>Lepomis humilis</i>	1949	1957	1971	1970	1970	1980
		1950		1972		1971	
		1951		1979		1972	
		1956		1980		1973	

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Orangespotted sunfish (continued)	<i>Lepomis humilis</i>	1957 1971 1972 1973 1975 1979				1974 1980 1990	
Orangethroat darter**	<i>Etheostoma spectabile</i>	1975					
Paddlefish	<i>Polyodon spathula</i>						1977 1979 1981
Pugnose minnow	<i>Opsopoeodus emiliae</i>	1975 1984		1975 1979 1984 1985 1987 1990			1986
Quillback	<i>Carpoides cyprinus</i>	1947 1950	1950 1970	1970	1970		1984
Rainbow darter	<i>Etheostoma caeruleum</i>	1974 1976 1977 1980 1997		1979 1995 1997			
Redbreast sunfish	<i>Lepomis auritus</i>	1976 1980 1981 1982 1983 1984 1986 1987 1988 1989 1990 1991 1992	1958	1976 1978 1981 1982 1983 1984 1986 1987 1988 1989 1990 1991 1992		1976 1978 1979 1981 1982 1983 1984 1986 1987 1988 1990 1991 1992	1977 1983 1990 1991 1995

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Redbreast sunfish (Continued)	<i>Lepomis auritus</i>	1993		1993		1993	
		1995		1995		1995	
		1997		1997		1997	
		1999*					
Redear sunfish	<i>Lepomis microlophus</i>	1950	1957	1952	1956	1970	1976
		1954	1958	1970	1970	1971	1979
		1955	1959	1971		1972	1980
		1956	1970	1972		1973	1981
		1957	1971	1973		1974	1982
		1970		1974		1975	1983
		1971		1975		1976	1984
		1972		1976		1977	1985
		1973		1977		1978	1986
		1974		1978		1979	1987
		1975		1979		1980	1988
		1976		1980		1981	1989
		1977		1981		1982	1990
		1978		1982		1983	1991
		1979		1983		1984	1992
		1980		1984		1985	1993
		1981		1985		1986	1995
		1982		1986		1987	1997
		1983		1987		1988	
		1984		1988		1989	
		1985		1989		1990	
		1986		1990		1991	
		1987		1991		1992	
		1988		1992		1993	
		1989		1993		1995	
		1990		1995		1997	
		1991		1997			
		1992					
		1993					
		1995					
		1997					
		1999*					
River carpsucker	<i>Carpionodes carpio</i>	1972		1988		1976	1988
		1973		1990		1984	1990
		1984					1991
River redhorse	<i>Moxostoma carinatum</i>	1956	1959	1972		1978	
		1972					
		1974					

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Rock bass	<i>Ambloplites rupestris</i>	1973	1970				
Sauger	<i>Sander canadensis</i>	1947 1951 1954 1956 1973 1974 1975 1976 1977 1978 1985 1995 1997 1999*	1954 1957 1958 1959	1970 1972 1973 1974 1975 1976 1977 1978 1986 1997	1956 1970	1970 1973 1974 1975 1976 1977 1978 1979 1980 1990 1991 1997	
Shortnose gar**	<i>Lepisosteus platostomus</i>	1947 1949 1979	1971	1987		1986	1977 1981 1982 1983 1988
Silver chub	<i>Macrhybopsis storeriana</i>	1974 1975 1976		1974 1975 1976 1978		1976 1978	
Silver redhorse	<i>Moxostoma anisurum</i>		1954 1957				
Skipjack herring	<i>Alosa chrysochloris</i>	1947 1950 1951 1954 1955 1956 1957 1972 1973	1950 1954 1957 1958 1959 1971	1952 1970 1972 1973 1974 1975 1976 1977 1980	1956 1970	1970 1972 1973 1974 1975 1976 1977 1983 1984	1976 1977 1980 1982 1983 1987 1989 1990 1997

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Skipjack herring (Continued)	<i>Alosa chrysochloris</i>	1974		1982		1985	
		1975		1983		1987	
		1977		1985		1989	
		1982		1986		1990	
		1983		1989		1991	
		1984		1990		1992	
		1985		1992		1997	
		1987					
		1989					
		1995					
		1999*					
Smallmouth bass	<i>Micropterus dolomieu</i>	1976	1950	1991		1979	1991
		1977	1954	1992			
		1980	1957	1993			
		1990	1959	1995			
		1991		1997			
		1992					
		1993					
		1995					
		1997					
		1999*					
Smallmouth buffalo	<i>Ictiobus bubalus</i>	1947	1950	1952	1956	1970	1976
		1950	1954	1971	1970	1971	1977
		1951	1957	1972		1972	1980
		1954	1958	1973		1973	1982
		1955	1959	1974		1975	1983
		1956	1970	1975		1976	1985
		1957	1971	1977		1977	1986
		1970		1979		1978	1988
		1971		1981		1979	1989
		1972		1982		1983	1992
		1973		1983		1986	1993
		1974		1985			1995
		1975		1986			1997
		1976					
		1977					
		1979					
		1980					
		1981					

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Smallmouth buffalo (Continued)	<i>Ictiobus bubalus</i>	1982					
		1983					
		1984					
		1985					
		1986					
		1987					
		1988					
		1989					
		1990					
		1993					
		1997					
		1999*					
Smallmouth redhorse	<i>Moxostoma breviceps</i>	1971		1970			
				1973			
				1977			
Spotfin shiner	<i>Cyprinella spiloptera</i>	1949		1974		1974	1978
		1973		1975		1977	1983
		1975		1976		1986	1987
		1976		1977		1987	1988
		1977		1978		1988	1992
		1978		1981			
		1979		1982			
		1982		1983			
		1983		1984			
		1984		1985			
		1985		1986			
		1986		1987			
		1987		1990			
		1988		1991			
		1989		1992			
		1990		1993			
		1991		1995			
		1992		1997			
		1993					
		1995					
		1997					
		1999*					

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Spotted bass	<i>Micropterus punctulatus</i>	1947	1950	1952	1956	1970	1976
		1950	1954	1970	1970	1971	1979
		1954	1957	1971		1972	1982
		1955	1958	1972		1973	1983
		1956	1959	1973		1974	1984
		1957	1970	1974		1975	1988
		1970	1971	1975		1976	1989
		1971		1976		1977	1990
		1972		1977		1978	1991
		1973		1978		1979	
		1974		1979		1980	
		1975		1980		1982	
		1976		1982		1983	
		1977		1983		1984	
		1978		1984		1986	
		1979		1985		1987	
		1980		1986		1988	
		1981		1988		1990	
		1982		1990		1991	
		1983		1991		1992	
		1984		1992		1993	
		1985		1993		1995	
		1986		1995			
		1987		1997			
		1988					
		1989					
		1990					
		1991					
		1992					
		1993					
		1995					
		1997					
		1999*					
Spotted gar	<i>Lepisosteus oculatus</i>	1970	1958	1971		1975	1976
		1973	1971	1978		1979	1977
		1974		1981		1981	1979
		1977		1983		1983	1980
		1979		1984		1984	1983
		1981		1987		1986	1985
		1983		1989		1989	1986
		1986		1990		1991	1989

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Spotted gar (Continued)	<i>Lepisosteus oculatus</i>	1987		1991		1993	1990
		1988		1993		1995	1992
		1989		1997		1997	1995
		1990					1997
		1991					
		1995					
		1997					
		1999*					
Spotted sucker	<i>Minytrema melanops</i>	1970	1959	1970	1970	1970	1976
		1971	1971	1971		1971	1977
		1972		1972		1972	1978
		1973		1973		1973	1979
		1974		1974		1974	1980
		1975		1975		1975	1982
		1976		1976		1976	1983
		1977		1977		1977	1984
		1978		1978		1978	1986
		1979		1979		1979	1988
		1980		1980		1980	1989
		1981		1981		1981	1990
		1982		1982		1982	1991
		1983		1983		1983	1992
		1984		1984		1984	1993
		1986		1985		1985	1995
		1988		1987		1986	1997
		1990		1988		1987	
		1991		1990		1988	
		1992		1991		1989	
		1993		1993		1990	
		1995				1991	
		1997				1992	
		1999*				1993	
						1995	
						1997	
Steelcolor shiner	<i>Cyprinella whipplei</i>	1976		1976			
		1986		1995			
		1987					
		1988					
		1992					
		1993					
		1995					
		1999*					

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Striped bass	<i>Morone saxatilis</i>	1997 1999*				1990	
Striped shiner	<i>Luxilus crysocephalus</i>	1977 1984 1990		1974 1975 1977 1979 1980 1983 1984 1992		1979 1982	1989 1990
Stripetail darter	<i>Etheostoma kennicotti</i>	1976 1977 1980 1985 1997 1999*					
Threadfin shad	<i>Dorosoma petenense</i>	1950 1951 1954 1955 1957 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984	1950 1954 1957 1958 1959 1970	1952 1970 1971 1972 1973 1974 1975 1976 1979 1980 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991	1956 1970	1970 1971 1972 1973 1974 1975 1976 1977 1979 1980 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991	1976 1977 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1995 1997

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Threadfin shad (Continued)	<i>Dorosoma petenense</i>	1985		1992		1992	
		1986		1993		1993	
		1987		1995		1995	
		1988		1997		1997	
		1989					
		1990					
		1991					
		1992					
		1993					
		1995					
		1997					
		1999*					
Warmouth	<i>Lepomis gulosus</i>	1949	1950	1952	1956	1970	1976
		1950	1954	1970	1970	1971	1977
		1951	1957	1971		1972	1978
		1954	1958	1972		1973	1980
		1956	1959	1973		1974	1982
		1957	1971	1974		1975	1983
		1970		1975		1976	1984
		1971		1976		1977	1985
		1972		1977		1978	1986
		1973		1978		1979	1987
		1974		1979		1980	1988
		1975		1980		1981	1989
		1976		1981		1982	1990
		1977		1982		1983	1991
		1978		1983		1984	1992
		1979		1984		1985	1993
		1980		1985		1986	1995
		1981		1986		1987	1997
		1982		1987		1988	
		1983		1988		1989	
		1984		1989		1990	
		1985		1990		1991	
		1986		1991		1992	
		1987		1992		1993	
		1988		1993		1995	
		1989		1995		1997	

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Warmouth (Continued)	<i>Lepomis gulosus</i>	1990		1997			
		1991					
		1992					
		1993					
		1995					
		1997					
		1999*					
Western mosquitofish	<i>Gambusia affinis</i>	1976		1982		1972	1976
		1984		1985		1973	1977
		1986		1986		1976	1979
		1987		1987		1980	1980
		1989		1988		1981	1983
		1990		1989		1983	1984
		1991		1990		1984	1985
		1992		1991		1985	1986
		1993		1992		1986	1987
		1995		1993		1987	1988
		1997		1995		1988	1989
		1999*		1997		1989	1990
						1990	1991
						1991	1992
						1992	1993
						1993	1995
						1995	1997
						1997	
White bass	<i>Morone chrysops</i>	1949	1954	1952	1956	1970	1976
		1950	1957	1970	1970	1971	1977
		1951	1958	1973		1973	1979
		1954	1959	1974		1974	1980
		1955	1970	1975		1976	1986
		1956	1971	1985		1977	1987
		1957		1986		1983	1989
		1970				1988	1990
		1972				1989	1991
		1973				1990	1997
		1974				1991	
		1978					

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
White bass (Continued)	<i>Morone chrysops</i>	1982					
		1984					
		1986					
		1987					
		1988					
		1989					
		1990					
		1992					
		1993					
		1997					
		1999*					
White crappie	<i>Pomoxis annularis</i>	1947	1954	1952	1956	1970	1976
		1949	1957	1970	1970	1971	1977
		1950	1958	1971		1972	1978
		1951	1959	1972		1973	1979
		1954	1970	1973		1974	1980
		1957	1971	1974		1975	1981
		1970		1975		1976	1982
		1971		1976		1977	1983
		1972		1977		1978	1984
		1973		1978		1979	1985
		1974		1979		1980	1986
		1975		1980		1981	1987
		1976		1981		1982	1988
		1977		1982		1983	1989
		1978		1983		1984	1990
		1979		1984		1985	1991
		1980		1985		1986	1992
		1981		1986		1987	1993
		1982		1987		1988	1995
		1983		1988		1990	1997
		1984		1990		1991	
		1985		1992		1993	
		1986		1993		1995	
		1987		1995		1997	
		1988		1997			
		1989					
		1990					

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
White crappie (Continued)	<i>Pomoxis annularis</i>	1991 1993 1997 1999*					
White sucker	<i>Catostomus commersonii</i>			1977		1977	
Whitetail shiner	<i>Cyprinella galactura</i>		1971				
Yellow bass	<i>Morone mississippiensis</i>	1971 1972 1973 1974 1975 1976 1977 1978 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1995 1997 1999*	1971	1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1995 1997 1999*		1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1995 1997	1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1995 1997
Yellow bullhead	<i>Ameiurus natalis</i>	1975 1980 1981 1984 1986 1987 1988		1978 1979 1980 1981 1982 1983 1984		1978 1979 1980 1981 1982 1983 1984	1983 1984 1985 1986 1988 1989 1990

Appendix 1. (Continued)

Common Name	Scientific Name	TRM 471.7-478	TRM 483.6-487.5	TRM 489.6-495	HiRM 1.2-3.5	TRM 505.4-508	TRM 524.6
Yellow bullhead (Continued)	<i>Ameiurus natalis</i>	1989		1985		1985	1991
		1990		1986		1986	1992
		1992		1987		1987	1993
		1993		1988		1988	1995
		1995		1989		1989	
		1999*		1990		1990	
				1991		1991	
						1992	
						1995	
						1997	
Yellow perch	<i>Perca flavescens</i>	1970	1970	1970	1970	1970	
		1971	1971	1971		1972	
		1972		1972		1976	
		1973		1973		1977	
		1974		1974		1978	
		1975		1975		1979	
		1976		1976		1980	
		1977		1977		1981	
		1978		1978		1982	
		1979		1979		1983	
		1980		1980		1984	
		1981		1981		1985	
		1982		1982		1986	
		1983		1983		1987	
		1984		1984		1988	
		1985		1985		1989	
		1986		1986		1990	
		1987		1987		1991	
		1988		1988		1992	
		1989		1989		1993	
		1990		1990		1995	
		1991		1991		1997	
		1992		1992			
		1993		1993			
		1995		1995			
		1997		1997			
		1999*					